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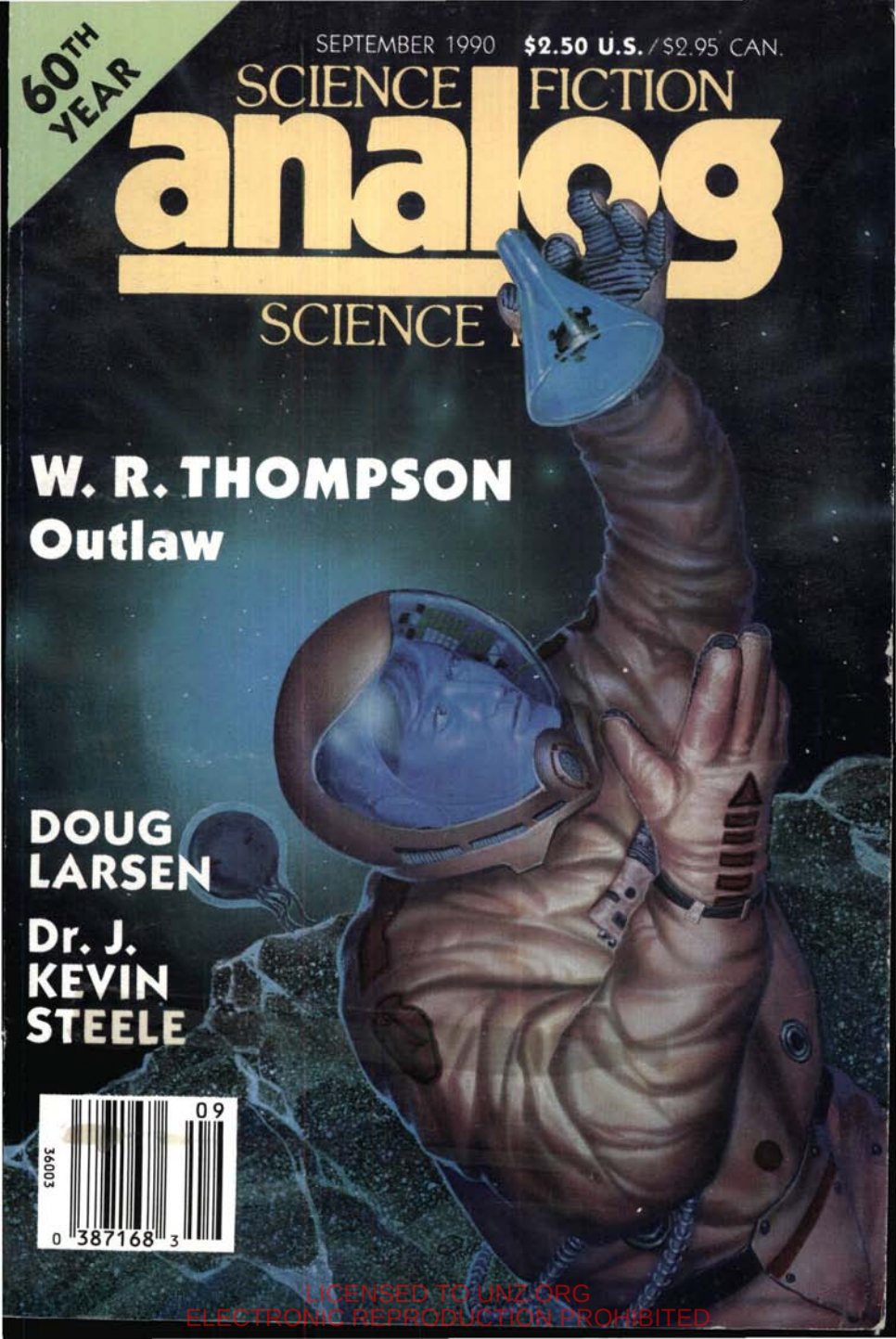

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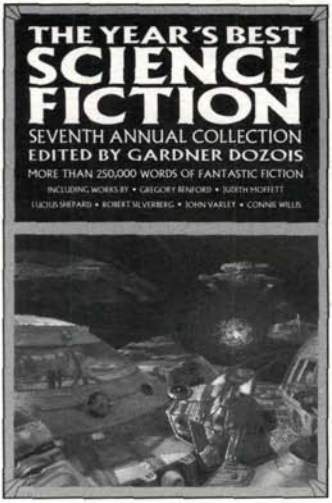
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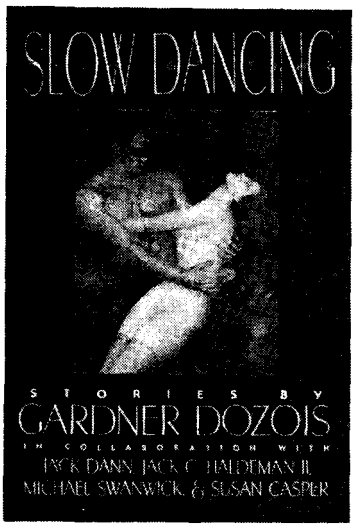

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Editorial

SENSORY DEPRIVATION

Stanley Schmidt

When I was in graduate school becoming a physicist, we had weekly colloquia by visiting speakers from other institutions. One of them was a Nobel Laureate; I don't remember *which* Nobel Laureate, or what his main topic was, but I do remember the story with which he opened his presentation.

It seems there was a professor doing research in neurophysiology who finally achieved a breakthrough late one night and was so eager to share his triumph that he collared the night janitor to show off his achievement. "Look," he crowed, "I've managed to capture all the knowledge and wisdom and experience of one human being in a chemical extract that can be injected into another person and give him the same benefits. People can be whatever they want to be, and by selling the potions that make it possible, I'll be a rich man. See these jars?"

The janitor followed the professor's pointing finger to a shelf filled with neatly labelled jars: "Essence of Chemist's Brain—$2,000/oz. Essence of Mathematician's Brain—$2,000/oz. Essence of Philosopher's Brain—$2,000/oz. Essense of Physicist's Brain—$35,000/oz."

"That's really something," the janitor granted. "But tell me—why is the physicist's brain so much more expensive than the others?"

"My dear fellow," the professor asked patiently, "do you have any idea how many physicists it takes to get an ounce of brains?"

The audience—consisting almost entirely of physicists—laughed enthusiastically. At least most of them did; when I consider my observations of the population at large, I wouldn't be surprised to find out that there were a few there who found it offensive and em-

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barrassing that a Nobel Laureate would waste even a half minute of his precious lecture time on a joke—and at the expense of his fellow physicists, at that!

I'm not sure that the number of people who frown on most attempts at humor is any larger than it's ever been—I can remember examples from quite early in my life—but I think it may be. I've been having the slowly growing impression that our society is going through a period of taking itself Ever So Seriously about practically everything.

Not everybody, of course. When *Analog* invited guest editor Kelvin Throop to produce a special spoof issue a few years ago, more people wrote to say they found it delightful than disgraceful. (Which was a pleasant surprise, actually, since people commonly only bother to write to editors when they're angry.) But there *were* a significant number of people who thought the whole concept was beneath such an august periodical's dignity, and even more who were offended by one or more specific items in it. This wasn't particularly surprising; I've noticed over the years that whenever we run *anything* funny, a few people can be counted on to register their disapproval. A fact article with humorous asides or footnotes will always produce a stiff reminder or two that, "Sophomoric humor has no place in a serious discussion of _____"(*You fill in the blank.*)

Apparently all editors, at least of "serious" publications, find the same thing. Hardly a week goes by that my local newspaper doesn't print a letter demanding Gary Larson's *The Far Side* or Bill Watterson's *Calvin and Hobbes* or Garry Trudeau's *Doonesbury* be dropped on the grounds that it's sick and disgusting. Nor are news and editorials exempt. A recent feature article started out:

> *"The message is becoming so abundantly clear, even beer companies are getting into the act. Drunken driving is no longer funny—or excusable."*

How many public figures would dare to attempt a humorous remark that even *mentioned* anyone's ethnic background, however innocuously, knowing that to some people *no* such remark could *ever* seem innocuous? And how often have you seen a humorous story, play, or movie win a major award?

Let me toss out a few quick responses to some of these observations before getting down to more methodical discussion:

(1) Some of us think that humor can have a place—an *important* place—in the discussion of just about *anything*. If nothing else, it can help to attract and hold a reader's interest, and make serious discussion more palatable and therefore more likely to happen. Whether it's "sophomoric" is very much a matter of personal taste; so, somewhat regrettably, it won't work the same way for all readers. However . . .

(2) The proper solution for readers who don't like a particular comic strip is: *If you don't like it, don't read it.* It's unrealistic to expect all readers of any publication to be equally pleased with everything it publishes. Just skip the parts you don't like, and kindly allow

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others with different tastes the same privilege.

(3) Drunken driving has *never* been excusable—but drunkenness can still be funny. It is possible for the same intelligent, decent person to laugh at a Jackie Gleason sketch involving an intoxicated character and to campaign vigorously for stronger legislation to fight drunk driving. Humor can even be used as a weapon against that or other evils; but the refusal or inability to see humor in a situation can be self-destructive.

One of the items in Mr. Throop's aforementioned spoof issue of *Analog* was Laurence M. Janifer's short story "Love in Bloom." The story grew out of the author's whimsically changing the famous opening line of Robert A. Heinlein's "Blowups Happen" from "Put down that wrench!" to "Put down that wench!" and then concocting a plot to go with it. At least one irate reader apparently read the story as condoning rape, and wrote a letter to which the author composed a thoughtful reply that

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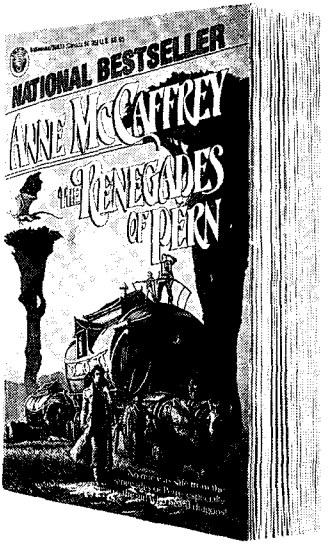

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deserves to be pondered by a much wider audience. He has kindly given me permission to quote part of it here:

> *"I don't consider rape or the threat of rape a casual and unimportant thing. I do consider it an improvement on murder, whether I get raped or you do, for the reason specified: post-rape, I'm alive. And I consider it, like death, insanity, and all other important things, material for humor. Nobody laughs at small items. People laugh mostly at big things, suitably presented. I like writing funny stuff and I like reading it, and I have no special worries about subject matter. At a few edges (the death of a child, for instance), the easiest form of humor is black humor, 'sick jokes' and the like. But* anything *is suitable material for funny treatment, I think . . . "*

And for a very good reason, too. For me, it's justification enough for some forms of humor that they can make necessary tasks more interesting and enjoyable. It's no coincidence that the very best academic course I ever took, in terms of what people *learned* from it, was also the one in which humor was a prevalent part of virtually every class session. But what can possibly justify joking about serious matters like death and insanity and prejudice of war? Let Hawkeye Pierce (of "M.A.S.H.") answer, as he answered when another character complained that he made a joke out of everything: "It's the only way I can keep from screaming."

Humor is an important mental safety mechanism. The sense of humor is a sense that human beings, individually or collectively, cannot afford to be deprived of. It's essential that we to try to solve problems, but the self-righteous sourpusses of the world must not be allowed to forbid us to laugh at them, too.

Humor is a unique phenomenon. As Arthur Koestler writes in the *Encyclopedia Britannica*, "Laughter is a reflex but unique in that it has no apparent biological purpose . . . . Its only function seems to be to provide relief from tension."

And a very important function that is.

Philosophers, psychologists, and physiologists have been trying for centuries to define and understand what humor *is*. It isn't easy, if only because it takes so many forms and is so different for different people. They seem to have done fairly well with identifying two common elements: (1) the perceiving of a single situation in two contexts or frames of reference, each internally consistent but not compatible with the other, and (2) some element of aggression. The latter may range from outright malice or contempt to a mere absence of sympathy for the victim of the joke.

This last might be compared to the "willing suspension of disbelief" that science fiction demands of its readers. For the duration of a joke, the listener must agree not to think too intently about how the person on the receiving end feels, or the story will become tragic

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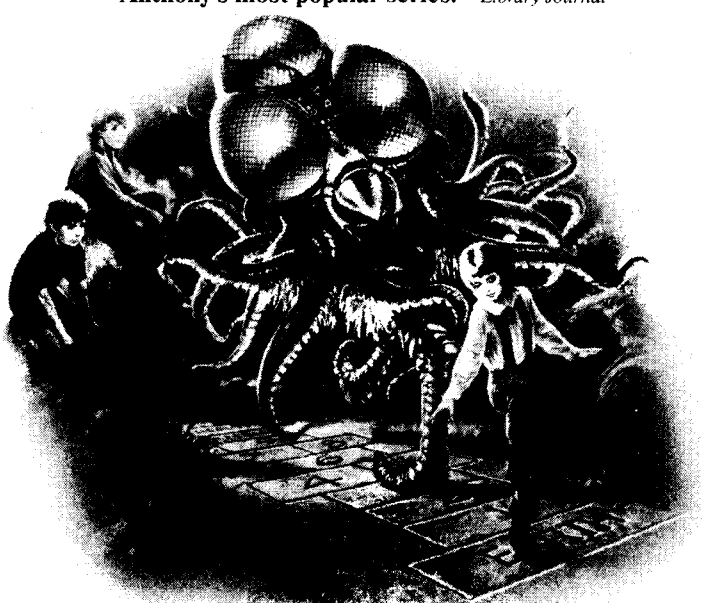

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or pathetic rather than funny. Thus kidding can't be too close to literal truth (satirists *must* exaggerate), and the humor of educated adults in civilized societies tends more toward the subtle than the malicious. Primitive hunters can laugh at the agonies of a mortally wounded prey animal because they don't have the concept of the animal being enough like themselves to inspire empathy. Civilized people do, so the aggressive element in their humor is more likely to be "so faint that only careful analysis will detect it"—or, as some might claim, far-fetched.

But what if it isn't? Might even coarser forms of humor have some value to humanity? Many people who have studied the problem have thought so. Aldous Huxley wrote, " . . . we tend to produce more adrenalin than is good for us, and we either suppress ourselves and turn destructive energies inwards or else we do not suppress ourselves and we start hitting people."

To which Arthur Koestler added, "A third alternative is to laugh at people. There are other outlets for tame aggression, such as competitive sports or literary criticism, but they are acquired skills, whereas laughter is a gift of nature, included in man's native equipment."

Humor provides an escape valve, a socially acceptable release for excess tension or hostile feelings. Given the choice, it is better to be laughed at by people who don't understand you than to be slaughtered by them. Is such a choice necessary? It would be nice to believe it isn't, but I'm not sure that's the way things really are.

It is true, as I've already mentioned, that humor has evolved. We are no longer amused by things that amused our distant forebears, because we have learned to empathize with more of our fellow beings. Is it not then all to the good that things change so that fewer things become funny? Isn't it a continuation of the evolution and refinement of humor that we've all become so empathetic that we now see foreigners and people of other races as fellow people instead of objects of humor?

It might, except that I don't believe that's what's actually happened, at least so far. Certainly it's true that *some* of us don't go in for ethnic humor because we've actually outgrown the need for it; but I fear that many avoid it because, and only because, they fear the consequences if they don't. And this may, in the long run, do more harm than good. It would be wonderful (or would it?) if we were in fact a society that had reached such a lofty peak of perfection that it no longer needed to laugh at anyone or anything. But it often seems to me that what we really are is a society that is trying desperately to delude itself that it has reached that peak before it actually has.

That in turn reminds me of the old cliché about closing the barn door after the horse is stolen. If a society decides to make it unacceptable to joke about certain matters, might it in effect be closing off the escape valve that was used to release excess tensions, before the source of those tensions has been removed? If so, the ultimate effect could

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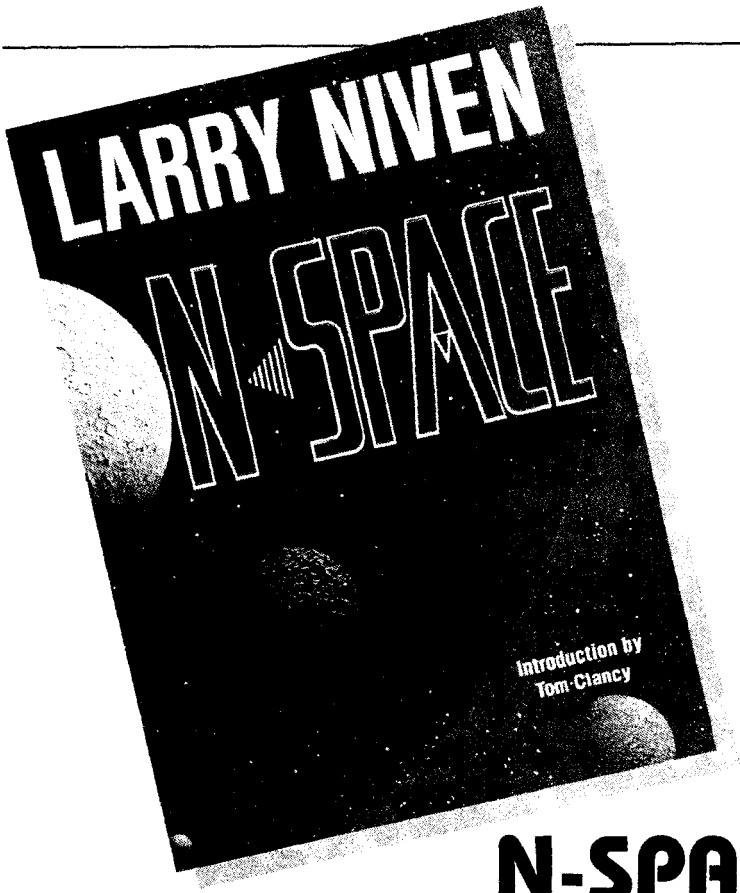

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be very much like that of "fixing" a house with faulty wiring by eliminating its fuses.

Need I elaborate?

If individuals want to deprive themselves of the ability to laugh, at anything or everything, that is their business. I may feel sorry for them, but I do not consider it my duty or right to try to change them. The blacks and Poles and blind and physicists I've known who were able to joke about themselves as well as others have generally seemed much higher in self-respect and happiness than those who couldn't. I suspect that eventually, when we have actually outgrown our present terror of offending or being offended, we will find fewer people inclined either to practice the crueler forms of humor or to overreact to remarks in which no real malice is intended.

But in the meantime, I object strenuously to those who would try to deprive others of their freedom to joke. Humor is much too important to lose. As the interpreter Sakini says at the end of John Patrick's play *The Teahouse of the August Moon*: "Pain makes man think. Thought makes man wise. Wisdom makes life endurable."

And a sense of humor is a vital part of wisdom. ■

●An important thing is never to stop questioning.

Albert Einstein

●The chances of failure are small, for only the unimaginative can believe that mankind's destiny lies on a small overstrained planet in a Galaxy of plenty.... The meek *shall* inherit the Earth, the rest will inherit a Universe.

A. Bond
Submitted by R. Ward

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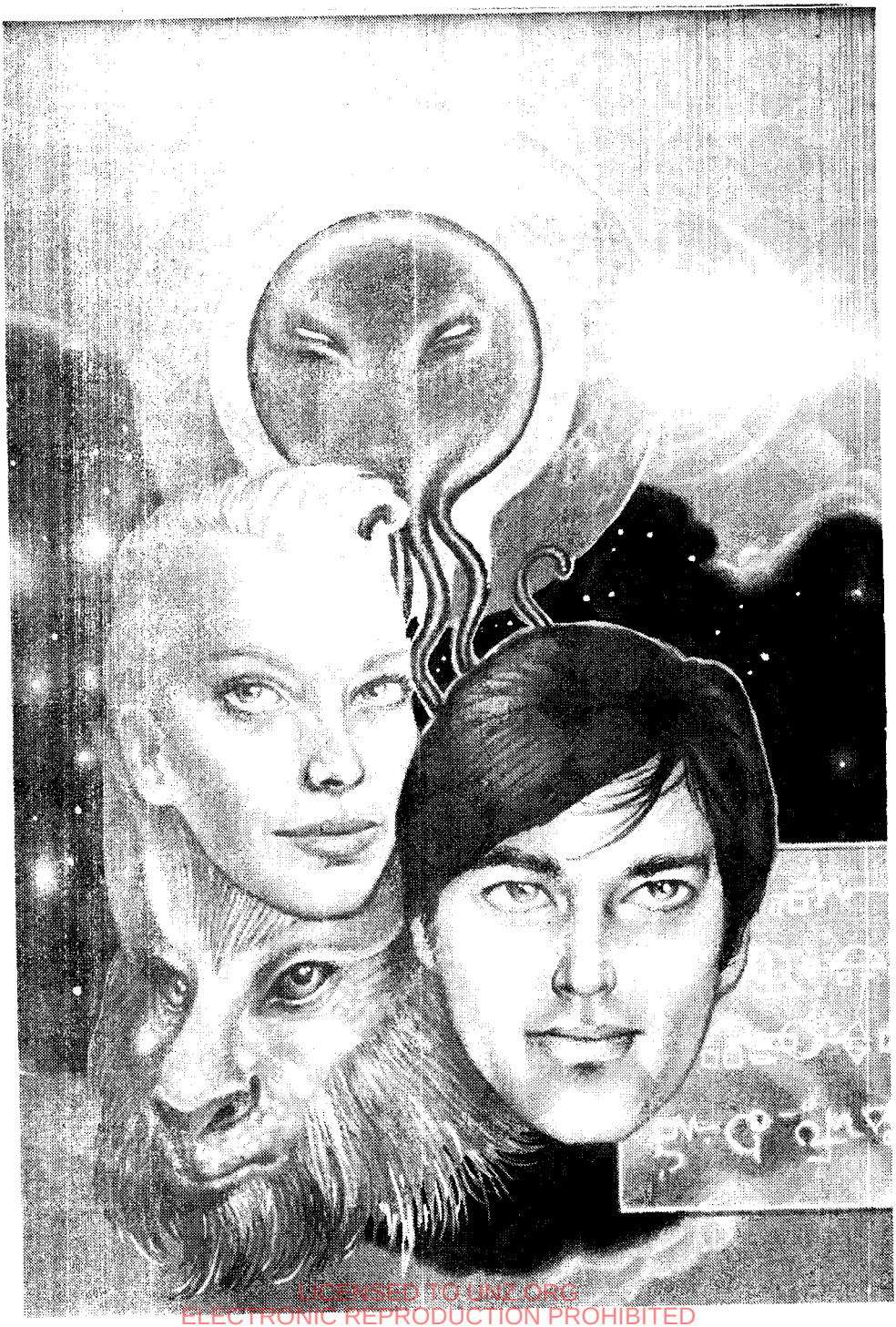

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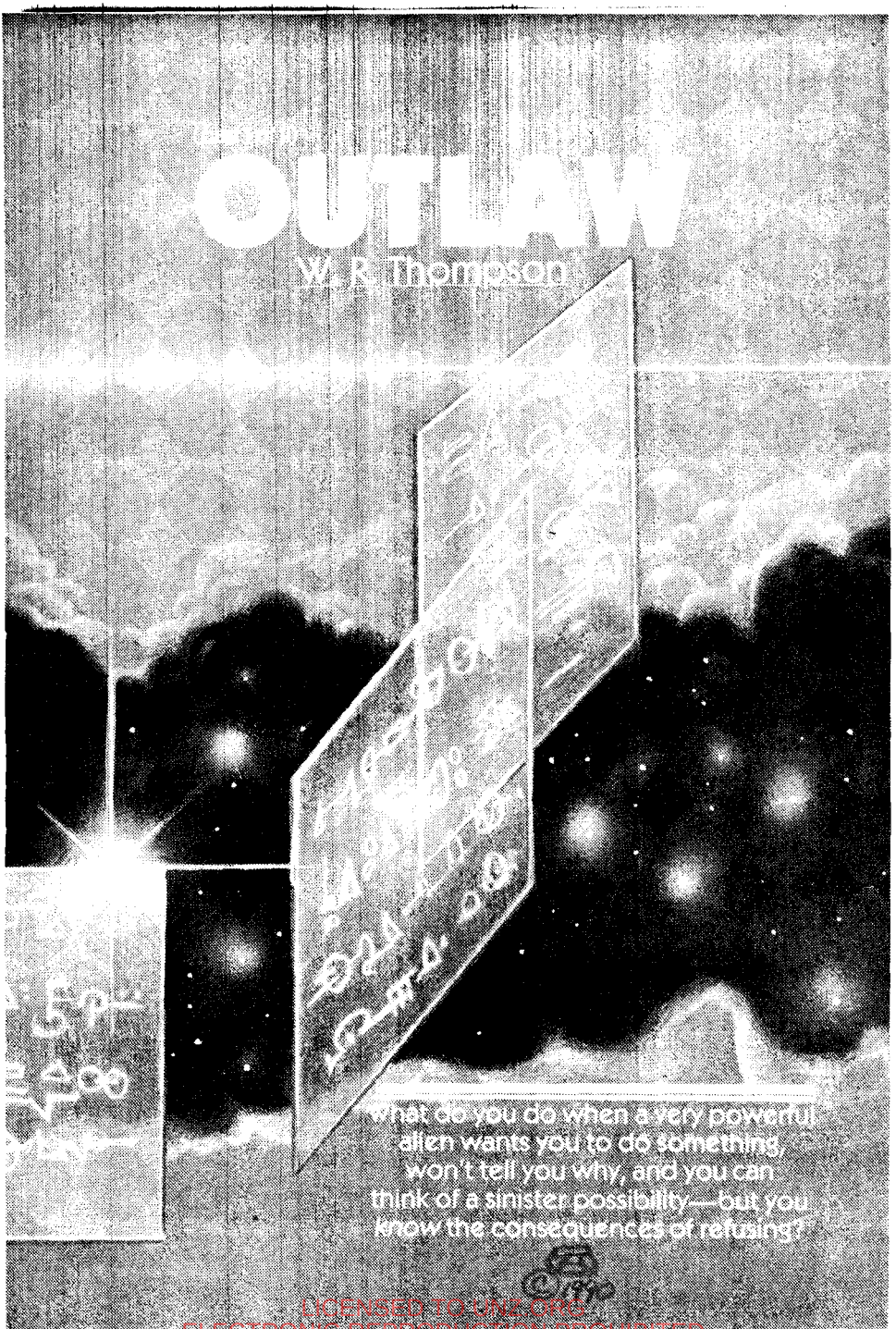

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1

New York City is a great place to get married, if you're an efficiency bug. There's a mandatory fifteen-minute waiting period after you apply for the license; this gives the computer time to run the medical tests and legal checks. After that, you sign the papers and you're a couple. There are no holdups; despite the jokes you hear about bureaucrats, the people in New York City Hall are efficient.

Perhaps too efficient. As Nancy O'Donough and I stood at a counter and filled out our forms, I noticed that the marriage window was right next to the divorce window, and the divorce line was moving as fast as the hitching line. It was funny, but the divorcee's looked as happy as the newlyweds-to-be.

When Nancy caught me looking at the divorce line she smiled sweetly. "John, did I ever mention I have a black belt in karate? And a red headband in baritsu?"

"I think you did, O'Donough," I said. "I was just wondering if the folks in the two lines ever talk to one another."

"We'll find out in a few minutes."

I nodded as I inked the pre-nuptial financial form, which is a hell of a thing to do on your wedding day. OK, it's practical and reasonable, but doing it right before you make the vows does spoil the romance. For that matter—"Are you sure you don't want a church wedding?"

She nodded, vigorously enough to make her blonde Mohican hair crest rustle like grass in the breeze. "I'm sure. I promised I'd explain things later, didn't I?"

"You did." I'd pressed her for an explanation during *Aurora's* flight home from Correy III, but she had turned stubborn. She wanted a simple wedding, and she wanted it as soon as we finished our debriefings at the UN. We had finished not half an hour ago, amid an assortment of diplomatic rages, tantrums and hissies. Maybe she was afraid her employers would find some way to mess things up if we didn't hurry.

Once again I wished that Lev Akhmetov would have done us the honors. As a starship captain he was empowered to perform wedding ceremonies. Unfortunately for us, Lev was a devout member of the Russian Orthodox church. He hadn't cared if Nancy and I slept together, but he drew the line at usurping a priest's functions.

I worked my way through the papers and came to the last form, the one to change my surname from Baxter to O'Donough. I looked at her. "O'Donough?"

"Yes, John?"

"Best two out of three?" During the Correy III expedition I had proposed to her by suggesting she change her name from O'Donough to Baxter. She had countered by suggesting I change my name from Baxter to O'Donough. We had compromised by deciding to toss a coin, which seemed reasonable at the time.

Nancy laughed at me. "You lost fair and square, buster." She picked up the papers and we got into line. Incidentally, the folks getting the divorces had nothing to say to anyone in our line;

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they were too busy swapping horror stories with one another. Loudly—maybe the *were* talking to us, in a way.

All that did was to annoy me and give Nancy a mysterious smile. "Should I take that as a warning?" I asked.

"You don't have that much sense." We got to the head of the line, handed in the papers and thus became man and wife. Nancy hooked her arm around mine. "Come on, Mr. O'Donough," she said.

We paged a limo. I gave the driver our destination, and while it lifted we settled into the passenger compartment. "So tell me," I said, "what was the rush?"

She looked innocent " 'Rush' ?"

"To get married," I said. "You don't have another husband stashed somewhere, do you?"

Nancy shook her head. "If we'd waited, we'd have had reporters up the wazoo—and Mom would have made an appearance."

"What's wrong with that?" I'd called my folks, who had been pleased to know I was finally tying the knot. They would have gladly shown up for the ceremony, if Dad's heart condition hadn't forced him to stay on the Moon.

"My mom?" She snorted. "You should have been there when she and Dad got married. I wanted a wedding, not a circus. Now it's too late for her to pull any surprises."

"She can't be that bad," I said. I didn't know much about Maya O'Donough, except that she'd been a punk-rock star around the turn of the century. Every so often Nancy would drop a hint about her, then clam up. One of these days, I told myself, I just *had* to meet that woman.

"She's that bad." Nancy looked at me and rolled her eyes. "Go ahead, look at me like I'm crazy. Don't believe me. Tell me about this honeymoon hotel instead. Is it private?"

"The guidebook says so. The place is in Vermont, in the Green Mountains, and it's not a honeymoon hotel—it caters to hunters and fishers. This is the off season, so it won't be crowded. By the way, our reservations are for 'Mr. and Mrs. Baxter.' I figured 'O'Donough' might attract attention."

"Good thinking." Nancy still counted as a celebrity, and assorted reporters had tried to lay hold of her since our return to Earth a week earlier. My meeting with the Nomads might have done the same for me, but that incident was so highly classified that even I wasn't supposed to know about it. That had been made clear during my debriefing.

I could understand their paranoia. The Nomads think the Universe is their oyster. The Correyites had felt the same way, and they had planned to found an interstellar empire. They would have conquered everything in sight, which would have been bad for the Nomads . . . so the Nomads had exterminated them. Imagine the panic if that news leaked on Earth.

The Nomads are gypsies, and when they need manufactured goods they buy them from planetary races. They've lived this way for at least the past fifty megayears. To sustain their lifestyle they encourage the growth of industrial civilization wherever they go. One thing they do is plant vaults on countless worlds, vaults which contain glass plates

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bearing scientific information. To use this information you need the plates from hundreds of vaults; some vaults are placed on inhabited worlds, so you have to learn to deal with alien races to accomplish anything, trading plates like kids swapping baseball cards. It's simple and effective.

Not eveything the Nomads do is so gentle. Empires and wars of conquest are bad for business, and anything that is bad for business is bad for the Nomads—their motives are entirely selfish, even if they benefit other races. The Nomads butchered the Correyites before they could make trouble, killing them with a fast-acting plague.

How did I know about this? Simple. Nancy had dragooned me into joining her on the Correy III expedition, to work as both a biologist and her henchman. At Correy III I had taken a spacewalk during an emergency aboard the *Aurora*. My walk had been interrupted when a Nomad popped up, grabbed me and hauled me away for interrogation. It had been a real pants-wetter of an experience, but during our little chat the monster had laid down a few rules for me. I had repeated them during my debriefing: humanity was expected to form an equitable business relationship with the kya, and act like peaceful businessfolk. Or else.

The UN didn't like those terms. The kya are a race of herd beings, and technologically they stand where we did a century ago, during the 1930s. The UN would love to do business with them—but on terms that keep the kya safely under our thumbs. The UN didn't like having fairness imposed on it, and that dislike showed when they interrogated me.

I still was ticked off over that debriefing, which had been more grilling than honest questioning. The interrogators had gone over my story again and again, looking for holes in it. It was obvious what they thought: I liked the kya; only I knew what the Nomad had said; why shouldn't I grab a chance to impose terms I liked?

During the trip home Nancy had warned me that they would take that attitude. She had advised me to cooperate; it was in everyone's best interests to convince the UN that I was telling the truth. OK, I had cooperated, but I hadn't enjoyed it. My least favorite memory was of being wired into a lie detector, like a common criminal, and listening to a robot voice assess everything I said. Whoever programmed that machine had a dim view of humanity, and ought to resign from our species.

At least the truth had prevailed. Just before we left the UN headquarters Nancy had learned that a treaty had been drafted in accordance with the terms the Nomad had laid out to me. The treaty would be signed as soon as it was smoothed out, in another week or so. It surprised me that the Security Council could act so quickly; up to now they had dithered over everything, as if hoping all their problems would go away before a decision was required. That's no way to run a government.

Nancy teased those thoughts out of me as the limo crossed the New York-Vermont state line. "That's a rotten thing to brood about on your honeymoon," she said. "You're supposed to be thinking about me, dummy."

"Forgive my inexperience. This is my first marriage." I looked out the

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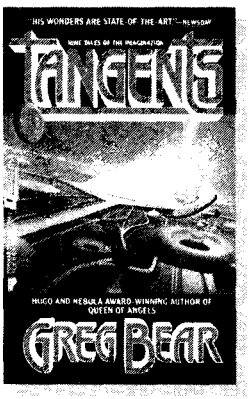
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A WORD FROM Brian Thomsen

If you want to know what lies just around the corner in the next century, talk to Greg Bear, but be prepared for several different alternatives. He might offer a future of sentient microscopic cells mutating mankind beyond recognition, or perhaps a utopian vision of a time when children can be genetically customized for excellence. Cities of comb-like architecture, entire populations undergoing psychotherapy, and man exploring both the cosmos and the microcosmos—it is all there on the printed page, fresh from the creative mind of Greg Bear.

And when you see me around, ask me what Los Angeles will be like in the next century (Greg Bear knows).

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window and pointed. "I think that's the place."

The limo was homing in on a small mountain town. I checked the driver's screen and confirmed that it was East Lamoille, which billed itself as the maple syrup capital of Vermont. That might have been the truth. The place was surrounded by miles and miles of beech and maple trees. Beyond that it was just a wide spot in the road—a score of houses and a few larger buildings, one of which was our hotel.

Like the rest of the town the hotel had an antique look, with clapboard construction and wrought-iron trim. The limo let us out at the front door and we went inside. The desk clerk was an old geezer in a red flannel shirt, and by my count he said seven words while I signed the guest book and picked up our room keys. He was surly, not taciturn, and the look he gave Nancy was frankly hostile.

I wondered if coming here had been a mistake. I hail from a small town, and I know something of what that kind of life does to the mind. Outsiders are generally welcome in such places—as long as they're not too different. Even without her Mohican, Nancy couldn't help being different.

How different? I'd met her a year ago, on Kya, where I'd been a biologist at the UN research base. The base's design had been Early Alcatraz, grey and bleak. Worse, we'd been isolated there. Life on the base had put our staff of two hundred people under enormous pressure, and most of us had slowly cracked up.

Before things blew apart, the UN had noticed that people who returned from the base were acting oddly. They figured that the kya were doing something sinister. For their part, the kya saw how we lived and behaved on the base, and they were scared silly. We acted like members of a Spartan military culture, and they had no way of knowing the base was an aberration.

The UN sent Nancy as a troubleshooter just before the blow-up. She had figured out the problem and discovered the solution. Humans and kya are both social beings, with much in common. She had acted like a maverick—shaving her head, giving peremptory orders, offending everyone in sight—and that let the kya see how humans reacted to outsiders. It helped them to understand us, which led to an improvement in our relations.

Most people would have tried something sensible: make observations, write a report, negotiate with the kya. Nancy had realized that the sensible approach wouldn't work. She had put on a gonzo act and kept it up despite the mounting hostility of the staff. Anyone who can do that is different, in a way you just can't hide.

I handed a key to Nancy and we went upstairs. "Quaint," she said as we entered our room. "How much are they paying us to board here?"

"More than you'd expect," I said. The room was small, and it looked old. The lights had a manual switch, and Nancy toyed with it while I put our bag on the bed. "Like I said, this place caters to outdoor types. If they made things too plush they'd attract more people, and crowds would wreck the sports business."

"I see." Nancy undid her blouse as

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she stepped into the bathroom. "Right now I'm going to take a bath—a bubble bath, at one hundred degrees, with chin-deep water." She paused, then raised her voice: "I said I want a bubble bath, at one hundred degrees, with chin-deep water. Damn!"

"What's the problem?"

"This stupid tub doesn't work, Mr. O'Donough."

I went into the bathroom and looked at the tub. It was another antique, and I had to diddle with some oversized knobs to get enough water at the right temperature. We had a tub like that when I was a kid, but that was some time ago, and I'd lost the knack. At least I remembered how to operate the toilet.

I unpacked while Nancy bathed. Everything we had brought had gone into one bag; we both believed in traveling light. I hoped that sharing a trait like that was a good sign. I wanted to make our marriage work . . . and I wasn't sure I was up to it.

Nancy finished her bath, dressed, and suggested we take a walk in the woods. "I've never been in a real forest," she told me as we left the hotel. "Are they all like this?"

"They vary." The hotel was right at the edge of the woods. We followed a footpath into the trees. "This is a typical deciduous forest biome—several species of broad-leafed trees and a variety of lesser plant species. Those are beech trees, and those are maples. The dings in the trunks of the maples are where they drive in the spouts."

"To get the syrup?" she asked.

"To get the sap to make the syrup." I pointed up, to the sky between the branches, where a V of geese flapped north. "Those are Canadian geese, migrating north for the summer."

"'North'?" Nancy looked puzzled, then nodded. "Right. They'd have to go north in the summer if they're going to fly south for the winter. John? Why *do* birds migrate?"

"That depends on who you ask." I kicked at a stone and sent it skittering into the leaves. "I say it has to do with food. The birds nest in the north, where there's plenty of food in the summer but not in the winter, and probably not enough light to look for food anyway. There's plenty of food in the south, but if they stayed there year-round they'd deplete the food supply and starve."

"So migrating gives the food supplies a chance to regenerate while the birds are gone."

"Right." I put a couple of things together. "You're thinking about the Nomads, aren't you?"

"Yeah." Nancy pulled me off the trail, and we sat down under a tree. *This* was more like it, I thought idly. Our flight home had been a working trip, one which left little time and energy for romance, and the time wasted at the UN had kept us apart.

Alas, she wanted to talk business. "Why do you think they migrate?"

"I don't know." I looked up at a patch of sky. I didn't want to talk about the Nomads . . . but we had plenty of time, I realized, and taking things slow can be fun. "I doubt it's instinctive, like bird migrations—intelligence can overcome instincts in humans and kya, and I don't see why the Nomads should be different. Frankly, I can't think of a reason for it."

"I see." She stared pensively at the

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ground. "I can't help thinking it's important. Migratory life isn't convenient, so *something* makes the buggers move."

"Maybe not," I said, I patted the ground in front of me. "We're used to life on a planet, with a fixed landscape. But comets drift around, and the Nomads evolved in zero-gee. I doubt they understand the concept of a sedentary life."

"So you think it's—damn." Her phone was ringing. She took the card from her blouse pocket, and I could see the effort she made to sound pleasant. "Extension sixteen-forty-five, Nancy O'Donough."

"Vse speaks, O'Donough." The kya biologist sounded upset. "The problem being severe, I must see you."

"Problem?" Nancy's hair crest twitched as her scalp and forehead wrinkled. "What problem, Vse?"

"The UN has decided not to sign the treaty!"

2

I waited in the lobby for Vse—alone; Nancy was making phone calls, and the desk clerk had gone to dinner. When Vse arrived we bowed and sniffed hello. "It's good to scent you again," she said.

"You, too, Vse." I had met her on Kya, where she had helped me study her home world's flora and fauna. Vse was a brilliant young biologist, and a great beauty by kya standards—and human ones as well, in the same way that a cat or a doe is beautiful.

I led her up to our room. "There is little official," Vse said after she greeted Nancy. She paced back and forth, her splayed feet slapping the wood floor, her muzzle wrinkled with concern. "The treaty negotiators have stopped speaking with our people. All members of your Security Council have gone home."

"Strange," Nancy said. We sat down on the bed and I slipped an arm around her waist. "Everything was fine this morning. What happened?"

Vse shook her head. That's not a kya gesture, but Vse used it for our benefit. "No one knows, O'Donough. Speaking with Ambassador Mrih, Delegate Singh mentioned a need to 'consult and amend the negotiating stance' with his government."

"Double-talk," Nancy said. "They're hiding something." She pulled out her phone. "Get me the UN headquarters, extension five-oh-two."

"That number has been placed on security restriction," a robot voice said.

Nancy swore. "Then get me extension twelve-fifty."

"That number has been placed on security restriction."

"Call extension seventy-one."

"That number has been placed on security restric—"

Nancy stuffed the card back in her pocket. "The senior negotiator, Non-Human Affairs, the American ambassador's private line—hell. It's not like any of them to be so clumsy."

" 'Clumsy'?" I asked. "They're being secretive."

"Clumsy," Nancy repeated. "When you want to keep a secret, the last thing you do is tell the world you *have* a secret."

"Then some event surprised them," Vse said, her muzzle wrinkling thoughtfully.

"*Someone* got caught with her skirt

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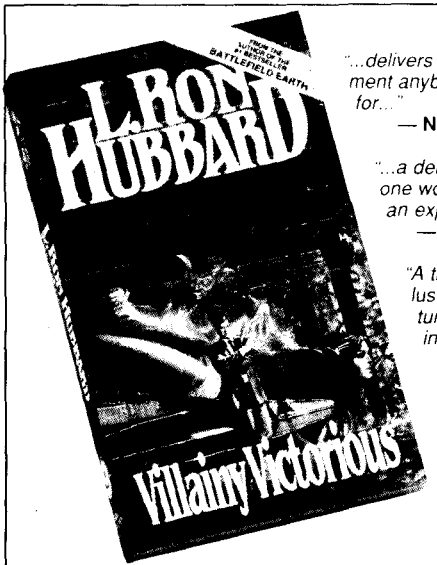

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up," Nancy agreed. With a sigh she took her phone out again. "I'll make some more calls and see what I can find. It'll take a while, so why don't you two take a walk?"

I hesitated, then glanced at Vse, and decided a walk might be a good idea. It would give her a chance to stretch her legs, and me a chance to question her—which I'm sure Nancy wanted. "Sure."

"Good. John?" She looked wry. "Disastrous honeymoons are a family tradition. Remind me to tell you what happened to Mom and Dad when they tied the knot. I wouldn't have believed it if I hadn't been there."

Vse and I left. " 'Honeymoon,' " she repeated carefully, as we left the hotel. "I don't know that word, Baxter."

"The final stage of the wedding ritual," I said. "A prolonged fertility rite."

She looked flustered. "Then I have come at an inopportune time?"

"Well—" Why make a friend feel bad? And it wasn't as if Nancy and I were a couple of panting virgins. "It's no big deal, although I expect Nancy will make some bad jokes about it. By the way, we both use the same last name now. It might be more convenient if you call us 'John' and 'Nancy.' "

"As you say." The kya have a terrific sense of smell, and recognize one another by scent; a kya "signature" is a dab of sweat and skin oils on a piece of paper. The kya only use names when they need to get someone's attention, or—ever since their development of the printing press, the telephone, and radio—when they need a convenient tag to identify someone who can't be scented. They think there's something weird about folks who have more than one name.

Vse and I talked as we walked into the woods, but she couldn't tell me much. Mrih had been talking with a negotiator that morning when the man was suddenly called away. No excuse was given, and it had taken Mrih an hour to find the delegate who fed him the "consult and amend" line. Meanwhile, all of the Security Council members were on their way home.

"Mrih being Mrih, he is suspicious," Vse said. I nodded in understanding. Mrih had been part of the Correy III expedition, and he'd nearly killed Vse and me as part of a stratagem to win control of the expedition for himself. Kya's ambassador to Earth was an ambitious, calculating SOB, and when it came to power politics he made Machiavelli and Nixon look like sissies.

"I am merely puzzled," Vse continued. "Could this be caused by internal politics?"

"Maybe," I admitted. "One nation could have decided it's better off without a treaty, or that it could get concessions by blocking a treaty. Or maybe the UN decided Earth can still make a profit, and they're arguing over who gets what. Of course, if the Nomads get bored with all that they could settle the issue with another Flashplague."

"Indeed." Vse exhaled. It was an unpleasant subject, even if we weren't talking about the possible extinction of her species. She stopped, hunkered down and examined a dandelion. "This looks like the flowering oilpad."

"It's more like an immature dust-

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puffer," I said, glad that Vse wanted to change the subject. I squatted down with her and we talked comparative biology, which for my money is more fun than politics. Earth and Kya, and the other biologically-active worlds, display innumerable examples of convergent evolution: organisms which have evolved almost identical structures and mechanisms, despite being separated by interstellar distances. It's as if evolution follows the path of least resistance whenever it creates a life-form to fill an ecological niche.

After a while Vse and I went back to the hotel. Her bare feet left splayed tracks on the soft dirt path. Seeing them, I was sorry it wasn't the hunting season. I would have paid good money to see the look on some hunter's face when he found those tracks.

The desk clerk was back on duty, and he looked even less pleased than he had when Nancy and I checked in. "You can't bring that animal in here," he told me. He clearly didn't think Vse could speak English.

I rose to my usual eloquent peak. "Huh?"

"We have *laws* in this state. Animals aren't allowed in public buildings."

"Check with the UN," I said. "Kya are legally human." I turned to Vse. "I'm—"

"Let him talk," she said—in kya. "I am curious."

I was mortified, but I obliged her. "Are you trying to create a diplomatic incident?" I asked him.

" 'Incident,' hell." The old man looked ready to spit. "I run a respectable house. I don't need any damned outsiders turning it into a freak show. Get that animal out of here."

My brain came back on line, and I decided to appeal to his patriotism. "She's a guest of the American government, and if the president has to apologize—"

"Let her!" he snapped. "If she was doing her job, people like you wouldn't make trouble for decent folk. You come in here with your jabber about UN laws and incidents—"

Nancy came down the stairs. "What's the problem?"

"I want that animal *out*," the clerk said. His voice was cracking with anger. "I want it out *now*, before any of the neighbors see it. And if *you* give me any guff about it being a person, well I've got the legal right to refuse entry to these here premises to anyone, and I am by God refusing!"

"Whatever you say," Nancy said. "John, let's leave. Will you get our bag while I pay the tab?"

"I don't want your money," the clerk said. "You just get *out* of my place!"

"After I get our things," I said. While Nancy and Vse stepped outside I went back to our room, where I found our bag already packed. I took it, and tossed my key to the clerk on my way out.

"Our car is on the way," Nancy said when I joined her and Vse on the grass at the roadside. She took our suitcase and used it as a seat. "It should be here in a few minutes. Vse, I apologize for that man's behavior."

"The blame isn't yours." Her furry muzzle twitched thoughtfully. "What motivated it? Was the man afraid of me?"

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"Not personally," I said. The kya don't have racism and don't understand it; they identify one another by scent, and odors don't come in ethnic groups. "It's fear of the unknown, of change. That guy—" I gestured at the clapboard building "—knows how to deal with his friends, or with his usual customers. But you're outside his experience—and he didn't want Nancy around, either. You both upset his world."

"He threw us out so he wouldn't have to change?" Vse asked.

"Yeah. It was a kind of mental self-defense. Or laziness," I mused. "Change, adaptation, takes mental effort. We don't like that. Never mind what it says on the label, *Homo sapiens* is usually anything but the thinking kind. We'd rather follow our habits than do any original thinking."

"Weird," Vse said. I hoped she meant what I was saying and not me. "But we should speak of other oddities. Nancy, did you learn anything from the UN? Nancy?"

"Huh?" Nancy looked startled, as if her mind had been a billion miles away. Or however far away the Nomads were. "Oh. I couldn't get anyone to admit a damned thing. Anyway—" She looked at the Sun, which was dipping toward the hills to the west. "—we still need a place to spend the night. Any suggestions, John?"

"We could head back to New York and get a hotel room."

"If we could find a vacancy. Which is unlikely on such short notice. There's something else we could try, although it's pretty drastic." She pulled out her phone. "Get my parents."

A man's voice answered after a moment. "George O'Donough."

"Daddy? Nancy—"

"My favorite daughter! What's this I hear about you getting married?"

"I grabbed that biologist I told you about." She was smiling now. "And he just got us kicked out of our hotel—"

"*What?* Where are you?"

"Reduce Speed, Vermont. Could you put us up for the night?"

"I don't know. Is this biologist housebroken?"

"Almost. We're bringing along a friend. Ask the kya legation to send her some munchies, OK?"

"OK. See you when you get here."

Nancy put her phone away. "I can always count on Dad. And he knows some people; he can check a few things for us."

I heard a hum, and looked around in time to see a taxi drop out of the sky. After we got in Nancy gave the driver a New York address, then switched off its hearing. "We can talk now," she said, as the car soared into the air. "John, that was good, getting us kicked out."

"How's that?"

"It looks less suspicious than checking out. Which we would have had to do anyway, because we have to get back to New York."

So that's why she had had everything packed. "What's going on?" That question was becoming the story of my life.

Vse squirmed around, trying to get comfortable on a human-contoured seat.

"I take it you heard something from the UN?"

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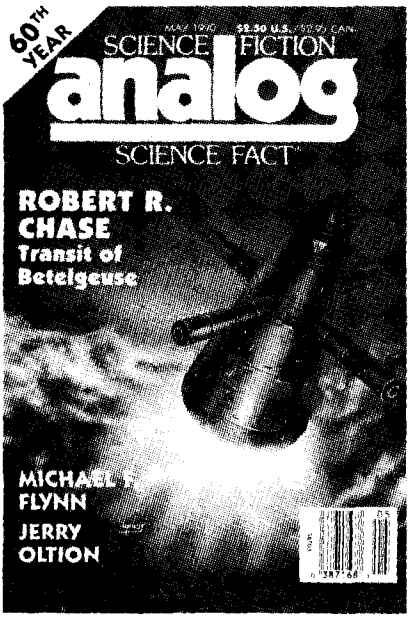

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"Indirectly. Do you know anything about Pluto?"

"One of your planets?" Vse shook her head.

"It's the ninth planet from our Sun," I told her. "It's about four billion miles out, and it's about the size of Earth's Moon. It's cold, around forty degrees above absolute zero, which is why we have a cryonics lab out there."

"That's what counts," Nancy said. "There are twenty or thirty people there. They had visitors today."

"Nomads?" I asked.

Nancy nodded. "Nomads."

3

Nancy's parents had a town house in SoHo, along the southern stretch of Broadway. I had known in an offhand way that the O'Donoughs were rich, but I hadn't thought about it. If I'd known they were *this* wealthy, I might have had second thoughts about marrying Nancy—I don't want to be mistaken for a fortune hunter—and settled for living in sin with her.

Which would have pleased Maya O'Donough.

A massive, swarthy man in his sixties was waiting for us as the car settled onto the rooftop. Nancy hopped out, grabbed him and hugged him for a long moment. I couldn't make out what they said, but Nancy's face showed contentment she had never shown before. Then she disentangled herself from the man and turned him toward me. "Dad, meet your son-in-law, John Baxter O'Donough."

"Call me George." We shook hands and he welcomed me to the family. He said nothing about my new name; George seemed to take it in stride. George gave me the impression that had Attila the Hun come ripping into his home, he would have invited him to stay for dinner, and done his level best to make sparkling conversation about rape and pillage.

George traded bows with Vse, and led us downstairs. "I take it you need more than a room," he said to Nancy.

"I need information. The UN is wimping out on the kya treaty."

George looked surprised. "I didn't even know they were ready to sign one. What's the problem?"

"I don't know, Dad. It has something to do with the Nomads showing up at Pluto." We came to the bottom of the stairs and entered a long hallway. "The whole UN is in a dither."

He chuckled. "I meant what's going on that's unusual? They—"

"Nancy!" a raspy voice shouted. One of the hall doors popped open and a woman stepped out of a room. She was shorter, more buxom and older than Nancy, but she had Nancy's face and green eyes. "How the hell are you?"

"Just fine, Maya." Nancy tensed up as she gestured at me. "This is my husband, John O'Donough."

Nancy's mother looked at me and grimaced. "Jesus H. Christ, Nancy, couldn't you at least marry inside your own species?"

"Not until I figure out what species I'm descended from." Nancy pointed to Vse. "This is Research-Instructor Vse."

Vse bowed and sniffed. Maya O'Donough grinned and stuck out her hand. "Pleased to meet ya."

Vse looked shocked; among the kya, only lovers shake hands. I had a feeling

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Maya knew that. Nancy rolled her eyes. "Maya, Vse isn't your type."

"You never know until you try, dear."

Nancy spoke to the ceiling. "My mother. Three platinum records. Eight gold records. Seventeen arrests."

"That's nine gold records. I re-released *Slaughter School* after the Kya Crisis. You still make good publicity, kiddo." She smiled brightly. "Hey, it's dinner time. I hope everyone brought their appetites."

I'd just about lost mine, but we went into a dining room and sat down. Servitors rolled in with trays; one gave Vse a typical kya dinner of breads, cheeses and raw vegetables. Vse picked at her food while Nancy and her father started discussing the day's events. She looked at Maya, once, then quickly looked away.

I could guess her thoughts. "The theory of evolution isn't perfect," I told her—in kya.

"Indeed." She graced Maya with another glance—unnoticed; Maya was frowning at Nancy—then looked to me. "She warned me about her mother, but I disbelieved her."

"Hey, you!" Maya was looking at me. "How is it that your last name is 'O'Donough'? Coincidence?"

"No, I changed it when we got married—"

Maya snickered and nudged her daughter. "How could you marry some schmuck without enough balls to keep his own name? What is he, one of those Commie faggots you work for?"

"We had an agreement," Nancy said. "We tossed a coin over which name to use."

Maya cackled at me. "You *tossed a fucking coin?* Were you dumbshit enough to use an honest coin, Jack?"

Some instinct must have told her that I hate to be called Jack. I decided I would have to match her, now, or suffer for the rest of my married life. Which might not be long. "It was my coin. That's what has me so pissed off. I still can't figure out how Nancy won."

The old bat looked at me, blinked, then looked to Nancy. Her voice was grudging. "OK, you can keep him."

Nancy looked strained. "I was going to do that anyway."

"John, you've made Maya's day." George looked and sounded as though he was enjoying Maya's behavior. "She's always wanted to be a classic mother-in-law."

"This is another human custom?" Vse asked.

"One that's almost out of style," George said. "By the way, Vse, thanks. Maya has always wanted to branch out and offend a non-human." Maya glared at him, and I realized he was gently—and effectively, it turned out— chiding her, by refusing to let her provoke him. Attila the Hun, the Scourge of God, wouldn't have stood a chance with George. "Now, Nancy said you talked with Delegate Singh. What did he tell you?"

"Ambassador Mrih spoke with him," Vse said. "Singh said that he was going to Pompeii."

" 'Pompeii'?" George repeated.

"A city in Indya."

"Oh, *Bombay*." Hypnolessons are fine, but if they don't include a word you'll have trouble when you run into it. "It's odd that Singh would go

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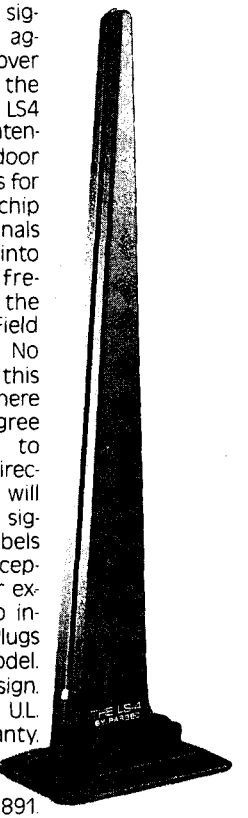

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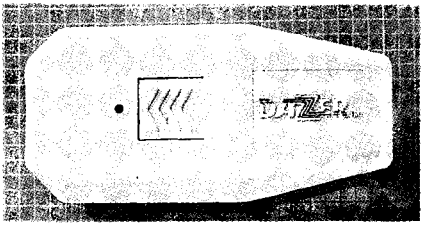

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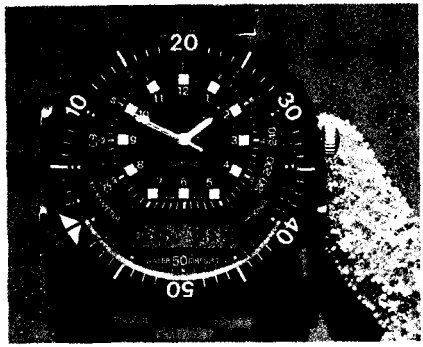

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there," George said. "New Delhi is the capital of India. What's in Bombay?"

"Tata University," I said. Then I shook my head; naturally that was the first thing to come to my mind. "But there are good universities in New Delhi, too."

"Perhaps this Tata University has unique specialists," Vse suggested. "Someone who could answer questions about Nomads, without mentioning the matter to non-Indyans."

"That's a thought," George said. He got up. "If you'll excuse me, I want to make some calls. We'll talk again later."

Maya stared at Vse for a long moment. "So tell me, snotface," she said at last, "what's kya music like?"

I didn't wake Nancy the next morning; only an oaf would disturb a sleeping woman, and there are times when I try not to be an oaf. I wormed my way out of bed, dressed, and slipped out of the bedroom.

It seemed everyone else was asleep. I sat down in the front room and picked up the first book I found, a large tome bound in leather and gold. It was the story of Manic Maya and the Madmen.

The publicist who had hacked together the book had shown exquisite bad taste. I slogged my way through fawning descriptions of concert tours, recording sessions and arrests, matched by lurid flatshots of the Madmen. The Mohican cut Maya sported in the pictures looked tame by comparison with the rest of her band.

Nancy was mentioned in spots. Maya had cut short the Armageddon 2000 tour when her pregnancy began to slow her down; a year later she scheduled the Millennial Hell tour around the needs of raising a child—although that looked more like hype than maternal love; the book made a big deal over Maya's unwed-mother status.

There was a whole chapter on the much-delayed wedding. The festivities had included hundreds of Maya's staunchest fans, dozens of hostile music critics, and—at the end—squads of riot police, all surreptitiously invited by the bride. Nancy had been a flower girl at the ceremony; the one picture of her showed a child who looked very lost amid the debris.

I put the book aside. Reading it made me feel as if I was invading Nancy's privacy. I wanted to know about her—but by rights she should be the one to tell me, not some anonymous publicist.

I heard noises from the bedroom. When I went back Nancy was on the carpet, oblivious to the world as she stretched through some isometrics. I watched her for a while; unclothed, she was a sight to inspire thoughts appropriate to a honeymoon, as well as to less formal occasions. "Good morning," I said at last.

"Good morning." She shifted into a new position. Baritsu exercises, I decided. Baritsu is the first martial art of the cybernetic age; the exercises are computer-tailored to suit the individual student, allowing for maximum use of strength and dexterity. Take my word for it, that gives advantages which have nothing to do with combat.

After a few more minutes Nancy seemed to relax. I knelt down behind her and started massaging her shoulders. To my surprise her muscles felt like

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knotted iron. "Are you all right?" I asked.

"I didn't plan to see Mom on my goddamned honeymoon."

She couldn't see my nod. "I'll never doubt you again, beautiful. You *did* try to warn me."

"Yeah." Nancy sighed and looked around at me. "Mom's on a mission from God, or something. It's her duty to expose hypocrisy and corruption and all that. And she doesn't know when to stop."

"She settled down last night," I said.

"Well, you handled her all right. Maybe you were a lion tamer in an earlier incarnation." She stood up, went to the closet and started dressing. "Mom isn't as much of a bitch as she pretends. Did you ever hear any of her works?"

"No." When I was a kid my father had owned some punk CDs, including Maya's albums, but I'd always valued my hearing too much to listen to them. "I never cared for that to-hell-with-everything stuff."

"Neither did Mom," Nancy said. "She wasn't a nihilist or anarchist; she did *protest music*. Against racism, against drugs, against war. There's a lot to be said for protest music, and Mom was good at it when folks needed to hear it." She looked distracted as she smoothed out her singlet. "Protest music has to have a nasty edge . . . but these past few years Mom's gone beyond nastiness."

"Is something bugging her?" I asked.

"Yes, but she won't talk to me about it." Nancy shook her head. "I just hope Vse is in a forgiving mood."

It turned out that Vse had no problem with Maya. When Nancy and I went downstairs we found them in the parlor, discussing kya life. "The Stormlords don't worship storms," Vse was saying. "They worship the chaos of storms. They claim they can control chaos by creating it."

Maya nodded as we sat down. She was slouching in her chair, but her eyes were alert as they scanned for exposed jugulars. "We have folks like that, but we call them Republicans. Hi, Jack. Have a good time last night? Everyone tells me Nancy's a hell of a lay." She jerked a thumb at a side door before I could speak and embarrass myself. "George is making some more calls. He said to tell you that Singh *was* at Tata U., talking to some experts on space manufacturing."

"That fits," I said. A servitor came out of the wall and gave Nancy and me breakfast rolls and orange juice. "Did George find out what they want made?"

"Naw. He said we probably don't have words for it, anyway." Maya returned her attention to Vse. "So, Snotface, what do you do when the Stormlords act up?"

"Having good lungs, I hold my breath until they pass," Vse said. "But the Stormlords are more of a threat to themselves than others. They worship 'Hnh, the chaos god, on hilltops during thunderstorms—and they consider lightning rods to be an affront to Old Sneeze."

"Ouch," Nancy said. She looked attentive; this was a wonderful opportunity to learn about the kya. My bride was a sociologist, and she subscribed to the school which said that you should learn everything you can about a culture.

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"Ouch, yes," Vse agreed. Her muzzle wrinkled. "And the stench is horrendous. But there are always new converts, you know? Stupidity is never in short supply."

"Sounds like our suicide cults," Maya said. A servitor rolled up to Maya and handed her a can of beer. She popped the lid and gulped it. "Ahh. They always make a big deal over how offing themselves shows their disdain for a corrupt society. Me, I'd rather stick around and show it."

Vse looked amused. "Nevertheless, it is thoughtful of them to cull themselves from the gene pool."

Maya nodded. "Yeah. I wish the viggies were that considerate."

"I don't know that word, Maya."

Maya cursed. "Damned foreigners never learn the language. It's slang for 'vigilantes.' "

"I don't know that word, either." Vse turned to Nancy. "I think she's making up words as she goes along."

"I wouldn't put it past her," Nancy said. "But that's a real word. Vigilantes are people who take the law into their own hands by killing criminals. Or suspected criminals, or someone they think might become a criminal some day, or someone who might get in their way."

Vse shivered. "Being dangerous, can't they be controlled?"

Maya snorted. "We've got laws up the butt against them. The thing is, they form clubs. One guy goes out, hunts down a victim and blows him away. The club supplies an alibi. Just try to prove there's a club, though. And even when you can, half the time the courts won't convict them because the jury *likes* what they did."

"So you can't rely on the law to stop them," Vse said.

"And you can't stop them yourself," I added, "without becoming a vigilante. Wonderful, isn't it? I wish I knew what causes it."

"It's crowding," Nancy said. "People need a certain amount of social contact to stay sane, but you can overdo it. When there are too many people, too many possible social interactions, people get overloaded and can't handle it. They try to cope by leaving the environment—usually through suicide or insanity—or by reducing its complexity. That includes murder, radical politics, odd religions that promise miracles and salvation—"

"OK, college girl," Maya said. "I already read your stupid doctoral dissertation." She snapped her fingers, and the servitor supplied her with more beer. I felt embarrassed for Nancy; despite the air conditioning the parlor air was thick with the smell of beer.

Vse ignored Maya. "You think crowding is a decisive factor in motivating vigilantes?" she asked Nancy.

"The math is hard to pin down," Nancy admitted. "And some people and cultures are more tolerant of crowding than others. But too much crowding always leads to violence."

"There's an experiment that shows that," I said, before Maya could open her mouth again. "You make a room-sized rat cage, put in twenty or so rats, and give them all the food and water they need. Rats are ideal for this experiment because they breed fast and have a simple society, one that's easy to understand." Nancy nodded at that.

"At first there's no trouble," I con-

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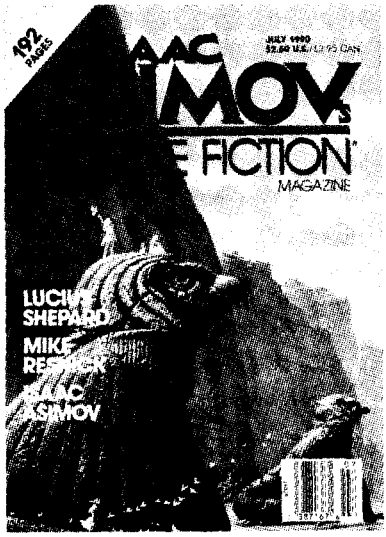

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tinued. "The rats set up their packs, with dominant males and group territories. They start reproducing and fill the empty space around them. Then things get a bit crowded, and there's friction among the groups, but they keep breeding.

"Now the population shoots up and things go to hell. The dominant males are so outnumbered they can't defend their territories. There goes the social structure. Next you get chaos, random fights and cannibalism."

Vse closed her eyes and exhaled. "The Stormlords would enjoy that. How long does that last?"

"Not long," Nancy told her. "That's when the rats lose interest in food and sex. They stop breeding and the population drops. You end up with a few old, neurotic rats, waiting to die."

"Predators," Maya groused. Even she couldn't have enjoyed this topic. "Boxed rats. Hell of a way for people to act. I wish you worthless scientists would find a way to fix things, Jack."

"A technical solution?" I rose above the temptation to snicker at her. "This is a social problem. Anything I can think of would treat symptoms instead of causes."

"I'd settle for a temporary fix until something better comes along," Maya said. Her eyes weighed me and found me wanting. "That great mind of yours can't find a way to tame some piss-ant viggies?"

I gave up. "What do you want? Voodoo? Black magic? That's what it'd take."

Maya looked slightly pleased by my crankiness. "How about psychosurgery?"

I shook my head. "It's unreliable. The exact same procedure can produce different results in different patients."

Vse looked intrigued. "What's psychosurgery?"

"The removal or modification of brain tissues," Nancy said. "It's illegal except in extreme cases. Anyway, vigilantes wouldn't submit to it. Viggies *like* violence and don't want to change."

"Then offer a change they would desire" Vse's eyes widened, a look of kya slyness. "Could you turn them into more efficient predators? Give them sharper senses, better musculature and reflexes—"

"Fangs, claws, maybe a tail with a poisoned stinger?" Maya rolled her eyes, the way Nancy did when she heard something idiotic. It looks better when Nancy does it. "Wouldn't *that* make life in the big city fun."

"Temporarily," Vse said. "Being superlative killers, I think modified viggies would tire of hunting lesser humans. They would turn on one another for a challenge. If not, they would become so dangerous you would be forced to act against them. Either way, the problem would be solved, no?"

Maya's jaw dropped, then clicked shut. "Get over here, idiot," she told the phone stand, and it rolled across the parlor to her. "Send this to everyone on the C list. Message starts. I feel inspired. Sober up and call me back, or it's your ass. Message ends. Let me know when you get answers."

"What's this?" Vse asked her. "I was only kidding."

"I wasn't," Maya said. "You've given me an idea for some songs. This'll teach *me* to say star exploration is a

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waste of money." She jabbed a finger at me. "Jack, d'you think any decent scientist could change a viggie into a super-killer?"

I shook my head. "Of course not. He'd say it's unethical."

Her laugh was vicious. "Unless you told him it's defense-related. Lots of you scientists go for that crap, shtunkhead."

I wasn't going to let this backbait bait me. "You said a *decent* scientist. Anyway, what you're talking about is engineering, not science. You'd only need a surgeon who knows the state of the art." Maybe I was exaggerating a tad, but this wouldn't require any breakthroughs. I could see ways to modify neural prosthetics and other goodies, although the AMA would crucify any surgeon who tried it.

"So we're talking about a real Doc Frankenstein." Maya looked happy. She sat up straight in her chair, which hastened to adjust to her new posture. "I could do a whole album on this. Maybe even a movie tie-in, with some killer visuals."

Nancy looked wary. "I thought you'd retired."

"A true artist never retires. I—oh, *there* you are." The door opened and George came in. He looked as though he'd gone without sleep last night. "You're a fine host, George, leaving our guests like this."

"But you're all I had, dear." He eased his bulk into a chair and looked at me. "John, you're an expert on the Nomads."

"Since when?" I asked. "Just because I was kidnapped by one—"

"You saw them in their natural habitat," George said, "and you successfully negotiated with them—you survived, and that's successful enough. I've got someone who wants to talk with an expert and as far as he's concerned you're it."

"Who?" I asked.

"Who cares?" Maya demanded. "George, I'm putting together a band. Are you going to help or are you going to waste time on these stupid Nomads?"

"Well . . . " He looked thoughtful. "You never take my advice, so I'll stick with the Nomads."

"You scumbag. I can never work around you anyway. I need more congenial surroundings. Something to inspire me. Get over here, idiot." The phone stand had returned to its corner; it rolled forth again. "Travel arrangements. Rent a half-dozen rooms, paid a month in advance, at—" She glanced at Vse. "—what did you call that chicken-shit hotel, snotface?"

Vse cocked her head. "I am unsure of pronunciations, Maya. The Lamoille Inn?"

"—the Lamoille Inn, in East Lamoille, Vermont. And charter a bus. Activate." She stood up. "I'm going to make some calls and pack. See you around."

"Where were we?" George said, after the door slammed behind Maya. "Oh, yes. Chris Dowling of Orbidyne wants to see you, John. He had a strange call last night and he wants to get to the bottom of it. His office is in Camden. He's sending a car."

" 'Orbidyne,' " I repeated. That was the space manufacturing consortium, which produced everything from microbots to starships. They guaranteed that

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if you could design it, they could make it.

"Does he know that John never goes anywhere without his blushing bride?" Nancy asked. She inclined her head toward Vse. "Or his faithful kya companion?"

"I'm sure he won't mind," George said. "Just don't overdo it when you pump him. Remember that we're the ones who owe him the favors."

4

A car was waiting for us when we stepped out onto the roof. We said goodbye to George, piled into the limo, and settled down as it climbed. Vse watched as the car threaded its way through the brisk morning traffic; I don't think she trusted robodrivers. Neither did I, but I had Nancy to occupy me. "It's been interesting so far, hasn't it?" I asked, snuggling with her.

"Like an earthquake, Mr. O'Donough." She sighed happily as I stroked her bare scalp. That was an odd, and oddly sensuous, sensation. Alas that we weren't alone. "But it should settle down, especially with Mom out of the way."

"Yeah." I could sense a powerful tension in this woman, and I realized she needed to talk about Maya. "I almost feel sorry for East Lamoille," I said, to give her an opening. "I wonder what Maya will do there?"

"Add to her legend," Nancy said. "Mom says she does her best work when she's surrounded by rage and hostility, so she'll do something to piss off the whole town. Like she did in—look, let's not talk about her now, OK?"

"OK," I said, feeling baffled. Nancy had sounded resigned, but also a bit proud. I could only guess that she had very mixed feelings about her mother.

But not about her father. "I like George," I said, to change the topic from Maya.

"Everyone likes Dad," Nancy said. "He has this way of paying attention to people, of making you the center of his world when he talks with you. I remember . . . "

"What?" I asked.

She sighed. "Mom had all sorts of boyfriends before she married Dad. None of them liked having me around—a kid gets in the way when you want to party. George was different, though. He'd always find time to sit down and talk with me like I was an adult. Most grown-ups forget how important that is to a kid, but George always remembered."

I couldn't figure out why she sounded so impressed by that. "Fathers are supposed to do that," I said.

Nancy looked amused, very wryly amused. "John, for a biologist you aren't very observant. Or didn't you learn about genetics?"

My mouth went *oh*. OK, a man who looks like George can have a daughter who looks like Nancy—but Nancy was telling me he didn't. For some reason I'd assumed that George was her biological father. What did being born out of wedlock have to do with anything, even when Maya was involved?

Nancy reached out, put a finger under my chin and pushed my mouth shut. "That's one reason Mom married Dad, and not one of those geeks she helled around with," she went on. "She said you could always tell about a man by

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the way he treated somebody else's kid. Mom's never been a fool. . . . and I think she knew she needed someone like Dad."

And George had felt the same way about Maya? I despised Maya, but that was because of the way she treated Nancy. Take that away and I could see why George liked her. There was something humane under that decadent shell—and something exciting as well.

"Odd," Vse said suddenly. "Is Camten part of your UN?"

"No, it's part of New Jersey," Nancy said. "Don't ask me what *that* is. Why?"

Vse pointed out the windshield. "We are heading toward the UN headquarters."

Nancy sat up and looked out. "What the hell?"

I looked and saw the UN complex dead ahead. I checked the driver and found that it had toggled onto a UN beacon—and the controls were locked. "It looks like you're being abducted by aliens," I told Vse.

She snuffled with nervous laughter. "Perhaps it is my turn, John. This being a high-handed act, should I lodge a protest?"

"Let's see what's going on first," Nancy said. "There's probably a good explanation for this."

Right, I thought, and Maya is a sweet little lady. I settled back and watched the UN complex expand.

We parked atop the tapedeck tower that housed the UN offices, where four security officers waited for us. They were big men, with the self-assured look of cops who are by God going to arrest you. "You will come this way," their leader told me. He sounded Germanic. "All of you."

I nodded and we went, crowding into an elevator. "They are armed," Vse said in kya. "I smell gunpowder, tear gas—"

"You will not talk," the leader said.

"Are we under arrest?" Nancy asked.

"You will not talk," the leader repeated. I decided he was eastern German; those Prussians like the authoritarian style better than, say, Bavarians or Rhinelanders do.

Nancy seemed relaxed, to my relief—but Vse looked annoyed. "Being human, you have no authority to arrest me," she told the leader in English.

"You will not talk." The elevator door opened. "Come along."

Nancy and I started out into the corridor, but Vse stood her ground. "I demand to see my ambassador. My rights being violated, I—swamp gas!" she swore.

The leader grabbed Vse by an arm and hauled her out into the corridor. "Come along," she was told.

"I protest this," Vse said, but she went along with us.

We ended up in the office of the American Ambassador. Wilkes was out, and we had to wait before she made her entrance. It was a short wait, just long enough to show us she was in charge. "Wait outside," she told the security officers as she seated herself. While they left she fussed with some papers, ignoring us, letting us stand like school kids in the principal's office.

"Doctor Baxter," she said at last, barely looking at me. "You're going to be charged with numerous violations of Resolution 1453. In case you've for-

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gotten—and you act like you have—1453 prohibits giving scientific information to the kya. The evidence, both eyewitness accounts and videos from *Aurora's* computer, is incontrovertible."

"Unless," Nancy said.

"Unless," Wilkes agreed. She looked at Nancy. "Unless you want your husband to spend numerous *consecutive* twenty-year sentences in Leavenworth—do I have your attention? You've been prying into secrets, O'Donough. That's going to stop. The events at Pluto and the suspension of negotiations are none of your business. You are going to keep silent about what you know and what you've guessed. And—" she looked pleased "—you are going to resign from the UN. Do that and I'll have the charges against Baxter suspended."

"Dropped," Nancy said.

"Suspended," Wilkes said. "The situation is too delicate for me to risk having you try something. I damned well mean to have you on a leash, you psychotic little bitch."

Where I come from, you do *not* talk to someone's wife that way. I was about to lay down the law to Wilkes when Nancy jabbed me in the solar plexus, not hard, but enough to silence me.

"Ahem," Vse said. "I don't understand this; why must Nancy resign? She does excellent work."

"Look at her." Wilkes spoke in the voice one uses with a backward child. "She's an embarrassment and I've had enough of her. So has the UN. She goes."

"Embarrassments must resign?" Vse asked. "Then being an embarrassment, you must resign."

Wilkes's face darkened with anger. "How dare you—"

"Properly, that is *my* question," Vse said. Coolly, she brushed imaginary lint from her cloak. "Accompanying my friends, I find myself hijacked. Refusing to explain their acts, armed humans grab me and drag me here. Violating protocols, they deny me access to my ambassador. Being their master, you are responsible for their acts, are you not?"

Vse paused and let Wilkes draw the inevitable conclusion. She had just bungled her way into a diplomatic incident. The UN itself may not have liked the kya, but a considerable chunk of the public did—and a lot of people, especially Americans, have never liked the notion of giving the UN police powers. Couple public opinion with the usual political infighting, and guess whose head would roll.

Wilkes gritted her teeth and tore up the papers. She touched her intercom button and dismissed the guards outside her office. "Get out," she grated.

"We're not finished," Nancy said. She snapped her fingers. "Two chairs, one stool." They rolled out and we sat down, with Vse perching herself on the stool. "Has the UN decided which side to take in the Nomad war?"

That got Wilkes's attention—and mine, and Vse's. "*What* war?" Wilkes demanded. She fixed her glare on me. "If you held back information, Baxter—"

"It's O'Donough," I said, just to throw her off balance. "I changed my name when we got married. And I told your people everything I saw, heard, and thought. Nancy, did you figure out something?"

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"I think so," she said. "The Nomads we met at Correy III expect us to form an interstellar trading market. It's their standard policy. They're so serious about this policy that they wiped out a race that wouldn't play by their rules.

"Now more Nomads show up at Pluto. They're going to let us abort the kya treaty, aren't they?"

"Yes, they are." Wilkes still looked angry, but a grudging thoughtfulness began to show on her face. "But why do you call that evidence of a war?"

Nancy backpedaled a bit. "At least, evidence of an economic conflict. It suggests that the Pluto Nomads are a different group from the Nomads at Correy III. They want to do business with us, but they don't mind if we *don't* form a market. Why not? Are they trying to turn us into a client race? Keep us from dealing with rival Nomads? Whatever's going on, we can be damned sure our visitors have *their* best interests at heart, not ours."

"But a war—that doesn't follow," Wilkes said.

Nancy shrugged. "A lot of wars have started as economic rivalries. And even if this is just some friendly business competition, client states never prosper. Look at Eastern Europe under the Soviets, or India under the British."

Nancy and Wilkes were watching one another closely, each trying to read the expression on the other's face. That must have been difficult; both of them would have made great poker players. Wilkes may have been older and more experienced, but Nancy's Mohican cut gave her an edge—that smooth expanse of forehead and scalp does something to the way you perceive a woman's face.

"You may have something," Wilkes admitted. "But there are other interpretations."

"I know. I don't have all the facts. The question is, who does?" Nancy leaned forward in her chair. "These Nomads—what did they ask for?"

Wilkes looked at Nancy for a long moment. "They offered a straight business deal," she said at last. "We build something for them in exchange for 'equitable payment in data and material.' What do you make of that?"

"I'd say that they mean it," Nancy said. "The Nomads don't joke about business—it's too important to them. If they think their offer is fair, they'll expect us to take it. Or else."

"Are the Nomads still at Pluto?" Vse asked.

"They were a while ago." Wilkes checked her terminal. She struck me as—not respectful, but no longer condescending to Vse. Getting outmaneuvered by a "backward" kya must have impressed her as much as it had frustrated her. "Yes. We get a report *via* tachyon link every ten minutes. They haven't left."

Nancy nodded. "How talkative are they? Do they answer questions?"

Wilkes's mouth twitched wryly. "They gave us their terms. Beyond that, they don't make idle conversation. The staff on Pluto hasn't pressed its luck by asking questions."

"Smart," I said.

"But we still need to know — everything." Wilkes drummed her fingers on her desk. "Which means questioning them, which means sending someone with experience. And, damn it, that

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means sending *you*, on an open-ended mission."

"With my team." Nancy gestured at Vse and me. "But first I need to see a transcript of the Nomad message."

"Non-Human Affairs will give you one. I'll arrange transportation to Pluto. Be ready to leave in forty-eight hours. But first—" Wilkes reached for her desk terminal and keyed in something. Sheets of paper rolled from a slot and she handed them to us. "Sign these."

More security oaths. Bureaucrats love computers; the machines can generate a form for any occasion. These forms bound us to keep quiet about Pluto, Correy III, and the Nomads. Nancy and I signed them; Wilkes had the sense not to force one on Vse.

We left the office. "Nicely done," I told Vse, once the door was shut behind us.

"I thought an incident would prove useful," she said. "We're supposed to be herd creatures, true? One expects us to defer to authority, to be push-arounds." Vse snuffled with laughter. "The cop and Wilkes both forgot that herds must have leaders."

And Vse had jumped in there and shown some leadership. On reflection, it was what I'd expect from her. She'd handled herself well during the accident on *Aurora*, and long before that she had made repeated visits to our base when the kya had thought it was a nest of alien monsters. Vse had guts.

There was something else. "You have a hell of a left hook," I told Nancy. My ribs still ached from her punch.

"It kept you out of trouble, didn't it?" She looked up at me and smiled. "But I appreciate the sentiment, John."

Nancy led us down to the Non-Human Affairs office. It was just a cubbyhole, tucked in between the census bureau and a roomful of statisticians. Non-Human Affairs was an afterthought of the UN bureaucracy, without any real power and few functions. That was understandable; until recently they'd only had dealings with the kya, and nobody had thought that was a big deal.

At the moment only one clerk was on duty. He checked Nancy's credentials, then gave her a computer printout. "You can't take it out of this office," he cautioned her, "and you'll have to return it when you're through."

"That's fine," she said. The clerk stepped into the back room and Nancy read the message. She scowled at it—it was a single page—then handed it to me. "What do you make of this?"

I read it.

Tombaugh Base, sgnl nr 943176-436-D-4 ref 65375-X Classified SECRET-5

NOMAD #1: WE ARE THE PEOPLE. YOU ARE THE HUMAN. WE WILL DISCUSS BUSINESS. DO YOU UNDERSTAND?

CARVER: I UNDERSTAND. WHAT IS THE BUSINESS?

NOMAD #1: WE REQUIRE THE MANUFACTURE OF A SOLAR ENERGY COLLECTOR/TRANSMITTER, TO BE SITED ON YOUR INNERMOST PLANET. WE OFFER EQUITABLE PAYMENT IN DATA AND MATERIAL.

CARVER: A SOLAR POWER COLLECTOR? HOW MUCH POWER DO YOU NEED?

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NOMAD #1: EXAMINE THE PLANS.

NOMAD #2: (TRANSMISSION DELETED) [1]

CARVER: JESUS.

MUFARA: WE CAN'T BUILD ANYTHING THIS BIG.

NOMAD #1: WE EXPECT COMPLETION WITHIN FIVE POINT ONE LOCAL DAYS. [2] AFTERWARDS WE WILL HIRE OTHER SERVICES AND PAY WITH DATA. WE KNOW MANY VALUABLE FACTS.

MUFARA: BUT WE DON'T KNOW HOW TO MAKE A THING LIKE THIS.

NOMAD #2: (TRANSMISSION DELETED) [3]

NOMAD #1: NOW YOU KNOW. THIS DATA IS PART OF OUR PAYMENT. THE FINAL PAYMENT WILL COME AFTER THE CRISIS.

CARVER: CRISIS? WHAT CRISIS? HELLO? WHAT [EXPUNGED] CRISIS?

MESSAGE ENDS.

Note [1]: Visuals and data are listed under a separate cover.

Note [2]: Reference is to Plutonian days (6.39 dy). Period is equal to 32.589 dy.

Note [3]: See Note [1].

I handed the message to Vse: I was puzzled; the message didn't mention the kya or the treaty, and Wilkes hadn't mentioned any "crisis." What kind of game was she playing?

Vse looked up from the page. "It doesn't justify backing out on the treaty."

"Right," Nancy said. "The UN felt that the kya treaty was being imposed on them, and that hurt their pride. The same goes for dealing with the kya as equals. Then some smart-ass looked at the phrasing of the Nomad message and decided he'd found a loophole. If the Nomads would do business directly with us then they wouldn't mind if we squirmed out of an agreement. Everyone bought that because they wanted to believe it."

A loophole? Only minds steeped in legalistic thought could find a loophole here, or imagine that the Nomads would let us climb through it. Then again, most politicians think in terms of hair-splitting legalisms. Look at the excuses they give when they break treaties or back down on campaign promises.

"We'll have to do something to make them see the light," Nancy said. "The first step is to find out what's going on with the Nomads, especially this 'crisis.' And we'd better be quick; they've already made a down payment."

"The plans," I said. "Do they think we agreed to this deal just by receiving the plans?"

"That's how I read it," Nancy said. "And if they suspect us of reneging . . ."

She didn't need to complete the thought: Correy III.

5

That afternoon Nancy, Vse and I reached the Orbidyne offices in Camden without further kidnappings or threats. "Although Wilkes still has our necks on her block," Nancy said as an elevator took us to Dowling's office. "That's why she had us sign new oaths. If things go bad, she can sacrifice us to cover her ass."

"I see." I'm not much at political machinations, but I was beginning to

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get the idea. No doubt we had already broken the oaths by discussing things with Vse. "Is there any way to defend our own posteriors?"

Nancy nodded. "Don't screw up."

The elevator door opened and we stepped into somebody's living room, complete with fireplace and shag rugs. "Oops," I muttered. "Wrong floor."

Nancy smiled faintly. "This whole floor is Dowling's office."

"You're kidding." Look: I'm a university type. I think of an office as a little box you share with another professor, two desks, and all the bookshelves you can cram in. A single office with a window is a luxury; a receptionist and private bathroom are extravagances reserved for university chancellors. That's as far as it goes on a campus.

Offices are a sign of rank in any bureaucracy. Like a moose's antlers, they're a good way to measure social status at a glance. Looking around me, I decided that Chris Dowling was the chief bull moose to end all bull mooses. And they say the kya act like herd creatures.

A receptionist took us into a side room. It was as plush as the main room—glassteel roof and wall, oak-trim furniture and a Persian rug—but it was also functional. A half-dozen men and women worked at computer terminals, and several of them spoke on telephones as they hit their keyboards.

After a moment a man got up from his terminal and approached us. He was in his sixties, lean and heavily weathered. "Well, Nancy," he said, and gave my wife a hug that took her feet off the carpet. "The last time I saw you, you were in high school, and your father had just talked me into donating two megabucks to the Neeser campaign."

"I remember, Mr. D. Dad's still unhappy that Neeser lost."

"So am I. We need men like him. Now, who are your friends?"

"This is Vse—" they traded bows "—and this is my latest husband, what's-his-name."

"You must be John Baxter," he said, shaking my hand. He had a grip like a blacksmith. "I've read your report on the Correy III expedition. Incredible."

It's nice to be recognized. "George told me you had questions for me," I said.

"That I do." He ushered us toward a small table in a corner. "Three chairs and a stool," he told it. The table extended the seats and adjusted its size to four people. "The Nomads want us to build a solar collector for them. What do you know about that?"

"We know it must be big," Vse said, "and that it must be completed within thirty-two Earth days."

"Can Orbidyne meet that deadline?" Nancy asked.

Dowling laughed without sounding amused. "That's what I'm trying to settle now. I think so. As for the size of the collector—holo display number seventeen."

An image appeared above the center of the table, a gray sphere that looked like the Moon. Red dots circled its equator. "This is Mercury," Dowling said. "The dots represent a chain of—of field generators, for want of a better term. The Nomad's instructions say the field can collect electromagnetic energy, everything from low-energy radio waves through infrared, visible and ul-

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traviolet light up to X-rays and gamma rays."

"How does this 'field' work?" I asked.

"I don't know yet," Dowling said. "The beast has features we don't understand. I've got a unit studying the parameters, and a lab team flanging up a test unit. Assuming it works—display eighteen." Clusters of blue dots appeared on Mercury, near each red dot. "These are lasers, twenty groups and eight per group. Display twenty-one."

Mercury vanished. A lunar landscape took its place. A disc sat on a cratered plain, connected to what looked like pipes and corrugated sheet metal. "The rectangles are heat radiators—small ones; the thermal efficiency is fantastic. The disc is the laser. It's a hundred yards wide."

"It must throw a hell of a beam," I said.

"And then some," Dowling agreed. "Each laser can handle up to ten to the twenty-sixth watts, which is about one-fifth of the energy the Sun puts out."

Nancy's jaw dropped, but to my surprise she didn't swear. " 'One fifth,' " she repeated. "But with all those lasers—the Sun doesn't put out enough energy to power them all."

"It may be a case of overdesign," Dowling said. "It must be."

"Unless—" Nancy looked concerned. "What if they got more power by blowing up the Sun?"

"Creating a nova?" Dowling shook his head. "If they did *that*, they'd blow up the collector, too."

"Oh." Nancy's chagrin showed. She didn't like displaying her weaknesses, and one of them was her ignorance of basic science. It's a common flaw, alas—ignorance, that is. At least Nancy knew it was a shortcoming.

"This system could be a standard design," Vse suggested. "Perhaps it is meant to be used on any star, even one much larger than your Sun."

"One size fits all," Dowling said. "From a red subdwarf to a blue supergiant. Unlimited power. There's only one question."

"What's it *for?*" I said.

"That's exactly what I wanted to ask you, John," Dowling said. "Any ideas?"

"Can those lasers be aimed?" I gestured at the holo. "It looks like a fixed installation."

"It is," Dowling said. "The disc is a solid-state affair. It can aim its beam anywhere in a thirty degree cone, *without* moving itself. If we can figure out how it does *that*, we'll revolutionize the laser industry."

"Can they be used as weapons?" Nancy asked.

"I think it's impossible," Dowling said. "The beams have a slew rate of less than a degree an hour."

"That's too slow to track a moving target," I said. It takes light five seconds to cross a million miles. One of those beams could vaporize anything at that distance, but in five seconds any self-respecting target could dodge out of the way.

Dowling was nodding. "Precisely. So what do the Nomads *want* with all that power?"

"It's not for industry," I said. "All the evidence says that they have other races work for them. My guess is that they're afraid of high energy levels. The Nomad I talked with at Correy III called

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liquid oxygen 'dangerously hot.' The one that grabbed me wore a heatshield, and I'll bet it felt like a daredevil, coming as close to a star as it did."

Dowling stuck to the point. "So we scratch industry and weaponry. What else is there?"

"Communications?" I asked.

"The Nomads have the overdrive," Dowling said. "Why bother with laser communicators? They could carry a message somewhere faster than light."

"Propulsion," I said, looking at the holo. All that power gave me an idea. "Maybe they want to swipe Mercury."

Dowling almost choked. "Prepos—no, by God, you may have something. One of those lasers would generate more than enough thrust."

Vse was puzzled. "Being merely a bright light, how could a laser work as a rocket?"

The kya don't know much about modern physics. "It can," Dowling told her. "We've thought of using lasers as rockets. In theory they're perfect, because they have a high exhaust velocity—the photons come out at the speed of light. The drawback is that we can't make lasers that can handle really large amounts of energy. If we build a ship with a laser drive, it couldn't accelerate at more than a thousandth of a gravity.

"But *these* lasers are so powerful. . . ." Dowling shook his head.

"So it could move Mercury," Vse said. She snuffled. I chuckled myself; the idea of stealing a planet was outrageous. I wondered why I'd suggested it. "Don't ask me why the Nomads would want Mercury," I said. "Anyway, they could fire two lasers on opposite sides of Mercury, and balance out the thrust. So Mercury goes nowhere. But it raises another question. All that energy going through that small area—that's a lot of force. What keeps that disc from crumpling like foil?"

"The disc itself," Dowling said. "It generates a field that amplifies the strong nuclear force, and that makes the nuclei of all the atoms in the disc try to bind to one another. That makes the material almost infinitely rigid. The field varies in relation to the energy going through the laser, so the forces stay in balance." Dowling's laugh was nervous. "Offhand, it's just an educated guess, but I'd say the Nomads know a few things about subatomic physics that we haven't learned yet."

"You may be right," I agreed.

"Yes." Dowling shook his head, and got back on the main subject. "Nancy, suppose we build this and it doesn't work. How could the Nomads react?"

She frowned. "Mr. D., that has to be a UN idea."

Dowling looked at her as if appraising her. "Yeah. They suggested that we modify the design, to give us some control."

Count on the UN to suggest something stupid. "That would be a bad move," I said sourly. "The Nomads destroyed Correy III because—"

Dowling gaped. " 'Destroyed'? I heard—John, your report said Correy III destroyed itself. Biowar or some such."

"That's the cover story," Nancy said. "The Nomads exterminated the locals because they wouldn't do business. They were trying to be *clever*, if

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you know what I mean. According to Nomad ethics, you either play their game to their rules, or you're dead."

Dowling swore under his breath. "So that's why—" He looked to me. "I *was* going to ask you why this was so urgent. The UN delegation wouldn't explain the deadline."

"That figures," I said. Christ almighty, I was glad we'd come here. If he had gone ahead with that idiocy—well, the UN would learn the hard way not to play games. That lesson was bound to come in handy when they convened in hell. "Have you got a copy of my report? I'd like to see what other changes they made."

"It was classified. I had to read it at the UN." Dowling made a fist and thumped it against the tabletop. "They lied to me." There was no rage in his voice, but it was clear he was fighting his temper. He took a deep breath, held it, then let it out.

"They lied to you," Nancy said. "But, Mr. D., the only thing you can do now is to build whatever the Nomads want."

"Because if I don't, they'll wipe out the human race."

"They just might," Vse said. "I would regret that."

"Same here," Dowling said. "Nancy, what if we can't make their schedule, no matter how hard we try?"

"I don't know how they'd treat an honest failure," she said, "and I don't want to find out."

"Neither do I." Dowling looked dissatisfied. "I'd better get working and meet that deadline. Say hello to your father for me, Nancy." He got up abruptly and went to a work station, effectively dismissing us.

We left the room and took the elevator to the ground floor. "I wonder who your government trusts," Vse said.

"No one," I said. "They're not in a trusting business. They can't even get along with one another."

"We can," Nancy said. "Maybe that's the problem. When we have to make the effort, we can get along fine with one another."

"Except when they go to war," I said. "Or put sanctions on one another, or—"

"Like I said, when we try." Nancy looked wry; it suited her face. "We're diplomats. We know how to get along with one another. The problem is, how do we deal with non-humans?"

I snorted. "Not very well."

"That's the problem," Nancy said. "Remember that schmuck at the hotel? He was faced with a whole new situation, with new rules and surprises. Most people handle those by wishing them away. That includes the UN. How do they deal with the kya? How do they keep from screwing up, and getting blamed when they do? Simple. They pretend the rest of the Universe isn't there."

By crawling into a shell. Crabs do that, but it doesn't keep them from getting served as dinner in seafood restaurants. "They don't understand that stupidity can get us killed," I said.

We paged our car and it glided up to us. "Don't sweat it," Nancy advised me as we piled in. She gave the car directions to the UN headquarters. "We'll make everything work out. I'd bet money on it."

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"At what odds?" Vse asked.

I snickered. "It's a sucker bet, Vse. If she loses, there won't be a human race, and good luck collecting."

Vse snuffled. "That being true, I want things arranged beforehand . . . and four to one odds."

Nancy looked indignant. "Robber! I'll give you two to one."

"Three to one," Vse offered. "I've seen the UN at work."

"Point taken. It's a bet. I'll put up five kilobucks." She looked out the window as the car flew out of the parking structure. We were headed in the general direction of Manhattan. "We should be talking about what we'll do at Pluto."

I already had some ideas on that. "All of my equipment is still aboard the *Aurora*. If we can get that ship again, it'll save the trouble of transferring everything to another ship."

"Good point," Nancy said, "although I think Lev was happy to get rid of us. What have you in mind?"

"After we finish at Pluto, I want to check a few random comets," I said. "Now that we *know* there's life out there, I can think of ways to find it."

"And learn about the Nomad lifecycle," Vse agreed.

"Much good may it do us," Nancy said.

"It just might," I told her. "We're in the dark about too many things. There's no telling what the right facts—"

"—might tell us," she finished. Her fingers smoothed a tuft of her hair crest. "I'll arrange things with Wilkes. I'm sure she'll be happy to see us go."

Yes, and she'd be even happier if we didn't come back.

* * *

6

Ah, zero gravity. Weightlessness. The joys of drifting and tumbling, of moving massive objects with the touch of a finger. Things that float in mid-air and spheres of water that dance and quiver before your eyes. The ninety-seven sexual positions documented in the NASA Sutra.

Ah, well. Nancy got sick the moment we entered orbit, even after she took some queaze-off. "Think I'm immune to it now," she gasped as she reached for a fresh barf bag. Space flight is her *bête noir*.

We rendezvoused with *Aurora*, and Vse and I helped Nancy through the docking adapter. I'd hoped to get her aboard quietly, but Lev Akhmetov was there, a one-man welcoming committee. His beard was in full bloom, making him look more bearlike than ever. He hugged Nancy, then applied the same Russian greeting to me. He gave Vse a kya-style bow, a funny sight in zero-gee, and sniffed hello to her.

"It is good to have you back aboard," Lev said as he escorted us to our quarters. "And I look forward to this flight. It should be far more exciting than the usual pre-set flight profile. We will have you at Pluto in a matter of hours, and then we will hunt comets." Lev's grin looked forced. "One trusts we will not find Nomads."

Nancy cursed feebly. "We're supposed to. There're some at Pluto, and we have to talk to the *yobanii govnyukii*."

Whatever that meant, it made Lev wince. We came to our old cabin, and he opened the door in silence. Once in-

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side I helped Nancy strap herself to the bunk. She closed her eyes and started taking deep, slow breaths, and I decided the best thing to do was to leave her in peace. I planted a kiss on her forehead and left.

Lev had already gone to the bridge, so Vse and I went to the rec room to watch the departure. *Aurora* was above central Europe, giving us a fine view of the Alps—and we had the view to ourselves; the crew was busy with their preparations, and we were the only passengers.

"I'm curious," Vse said idly. "This collector—can you truly build it so quickly?"

"Dowling thought so," I said. "It may push the limits of our technology, but he *is* an expert."

"I find it interesting that the Nomads know the limits of your technology," Vse said. "It would seem they spy on you."

"They probably learned about us by checking Tombaugh Base," I said. "Or they may have talked to the Nomads at Correy III. Come to think of it, they must have, because they found Earth without any trouble."

"That implies their civilization is extensive and well-ordered—" Vse stopped and snuffled in self-amusement. "But we already knew this." She went back to looking out the window.

It also implied that the Plutonian and Correy III Nomads were on good terms. I made a mental note to mention that to Nancy. It might give her a better handle on the "crisis."

We were over the nightside of Earth when Lev lit the engines. The maneuver lasted about two minutes. The verniers fired a moment later, tweaking the ship's course and lining us up for the jump. Then the stars vanished as we entered t-space. "Will we see Pluto when we come out?" Vse wondered.

"Probably not," I said. The window was small, and the odds were against seeing anything in it when we came back into real space.

The odds made a fool of me. A dim double crescent floated in the viewport: Pluto and its moon Charon. Both of them were too dark to show any detail; at this distance from the Sun there was less than a thousandth as much light as we get on Earth. If I hadn't known that Charon was only a quarter the size of Pluto I would never have been able to tell them apart.

The trip from Earth had taken only a minute in t-space, but we spent another four hours getting into orbit around Pluto. We had left Earth orbit with a certain high velocity, and now we had to lose most of that speed. Lev did that by putting the ship through t-space for a few pico-seconds—and emerging a mile or so above the surface of Pluto. Our velocity carried us away from the planet, while Pluto's gravity pulled and slowed us.

The process is called vector matching, and we repeated the maneuver six times. It's the sort of clever, fuel-saving gimmick that spacers love, but it's damned hard on the rest of us. T-space is ruled by Heisenberg's uncertainty principle, which means that you can't predict exactly where you will pop out of it. The odds were only one in a million that we would emerge under the surface of Pluto, but I think Lev crowded the odds.

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We lived to enter orbit, and Nancy lurched out of her cabin, visibly wilted. "I feel like I french-kissed a vacuum cleaner," she rasped.

"We'll have gravity soon," I told her. I could hear the attitude thrusters firing to spin up the ship, although it would take a minute to get the ship up to speed. I took her to the galley, and prepared some rehydrating mix for her.

She downed it and tossed away the container. It drifted lazily in the low gravity. "*That's terrible. Disgusting.* Putrid."

"So you're in the right mood to talk to the Nomads."

"You got it." She ran her hand over her scalp. "I must look awful, but they won't mind."

"You look wonderful," I said. Before she could call me a liar I went on, "Have you got any idea of what to say to the things?"

"*I think so. C'mon, Mr.* O'Donough."

Nancy led me to the bridge, where Lev and his engineer were shutting down the overdrive unit. "I had a signal from Tombaugh Base," Lev said. "They have new information on the Nomads."

"Another message?" I asked.

He shook his head, making his bushy beard waggle. "No, this is tracking data. Their neutrino telescope detected a large number of neutrino sources, at distances of one to two light-years from the Sun."

"Which means the Nomads were there one or two years ago," I said. Neutrinos travel at the speed of light, so they'd been on their way quite a while. With the overdrive the Nomads could have been far away by now.

"I'd like to talk to the Nomads now," Nancy said. "*Could you arrange that,* Lev?"

"Certainly." Lev turned to the communications panel. "The base said that the Nomads use low-frequency, low-energy radio signals as well as neutrinos. Fortunately our equipment can handle such a configuration." He handed Nancy a microphone. "Be my guest."

"Thanks." She pushed the talk switch. "We are the humans. You are the people."

A flat voice answered from the bulkhead speaker. "State your business."

"We wish to discuss the construction of the power collector."

"Continue."

"You will use a large amount of power. Will you use it in some task which we could perform better ourselves?"

That was a clever means of extracting information, I thought, and probably a safe one: a business proposition. If the Nomads were as business-oriented as we thought, they couldn't blame us for checking out the market.

Too bad it got us nowhere. "We must perform the task ourselves," the alien voice said.

Nancy looked at me and shrugged, as if to say *here goes nothing.* "Your last communication mentioned a crisis. Would our services interest you?"

"No. The crisis is an internal problem and your species is not relevant to it. Do not interfere."

"Understood. There is another matter. We are not entirely certain that the collector will operate."

"It will operate if properly constructed. There is no reason for failure."

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There was a pause, then: "The intent of your questions is clear. Know this. You have the ability to build the collector. We need it to resolve our crisis. We will punish failure or breach of contract." The radio clicked off.

Nancy handed the mike back to Lev. "Could you relay that to the UN?" she asked him.

"But of course." Lev sounded dry.

Nancy didn't seem disturbed. "They're sharp," she said idly. "That one knew what I was really asking. At least we know they're touchy about whatever they have planned."

"And we still don't know what to expect." The direct approach had failed, so it was time to make like a scientist: open my eyes and mind and see what I could learn. "Are the Nomads in sight?" I asked Lev. "I'd like to look at them."

"A moment." He linked the navigation telescope into the video display, and in a moment we had a flatscreen picture of the two Nomads. There was no spaceship, of course. The Nomads evolved in open space, and require no protection from vacuum. They get around with a backpack stardrive. "This is the best image I can provide," Lev said.

"It'll do." There was little light this far from the Sun, and the pancake-shaped Nomads themselves were pitch black. Despite that the instruments gave us a passable picture. The Nomads wore heatshields identical to the one used by my abductor at Correy III. Maybe that meant they were members of the same Nomad flock.

I thought of something. We could see the Nomads themselves, which meant light was falling on them. "Are those shields pointed square at the Sun?"

Lev checked some readings. "They're at an angle. Is that important?"

"The things are in direct sunlight," I said. "How are they keeping cool?"

"Good point," Lev muttered. He tapped buttons on a panel. "There is precious little energy here, but it is enough to boil liquid helium. Unless —yes, here is the infrared picture."

Seen in IR light, the Nomads were too cold to be visible. The backs of their heatshields, however, were comparatively bright, with a well-defined warm spot at the center of each shield. "I should have guessed," I said. "The shields are also heat radiators. That's how that one monster got so close to Correy III without frying itself."

"Is any of this important?" Lev asked.

"I wish I knew," I said. The trouble with facts is that they never tell you if they're important. By the time you figure out their worth it can be too late to do any good.

7

Lev had questions. We went to the mess hall and had dinner while I told him what little I knew about the Nomads and Mercury, along with our speculations. He pumped me for details, but if he had any thoughts on the situation he kept them to himself.

Nancy had stayed on the bridge to talk with Tombaugh Base, but by the time I had Lev filled in she gave up and came down for dinner. "I got a lot of nothing," she said as she joined us.

"It's called negative information,"

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I told her. "What couldn't they tell you?"

"Oh, everything." She tasted her meal, which was some sort of breaded mutton. That's a thing I liked about *Aurora*: the food looked and tasted like food, instead of the junior-astronaut crud served aboard Western ships. My only complaint was that, instead of packing along beer, *Aurora*'s galley was loaded with a Russian drink called Kvass. Kvass tastes like it's made from burned bread. Mildly alcoholic, it is only mildly drinkable. "Tombaugh Base doesn't know how many Nomads are here, or their precise orbits," Nancy said. "They can't get a fix on them."

"Odd," Vse said. "Shouldn't that be simple?"

"Beats me," Nancy said. "Lev?"

"I'm not familiar with Tombaugh Base's equipment," Lev said. "But it should be easy to track them." He looked to the flight engineer. "Igor Petrovich, go check the orbital elements of the Nomads. And—share the data with the base. Perhaps they would enjoy some accurate data."

Lev was smiling. Russian equipment isn't always as sophisticated as the stuff other nations make, and the Russians rankle at their perceived inferiority. Lev couldn't pass up a chance at one-upmanship.

The crewman left and Lev addressed me. "John, I am concerned about this comet hunt. There is no guarantee that a high percentage of comets bear life. Given that there is an average of less than one comet per cubic astronomical unit, and that it is difficult to locate them, we could be out there a long time."

"There's a way to improve the odds," Nancy suggested. When Lev raised his woolly eyebrows she went on, "Where there are Nomads, you're bound to find other life forms, aren't you?"

"That is inevitable in any ecology," Vse said. "The larger animal forms feed on smaller forms, and their life cycles support one another. John saw lesser forms when he was abducted."

"What is your point?" Lev asked Nancy.

"That we go some place where we know the Nomads are, or at least were. How good a fix did Tombaugh have on those neutrinos?"

Lev hesitated. "The angular directions were precise, but the distances were problematical. The best figures are for a source thirteen light-months distant. Nancy, I am less than enthused by the thought of jumping into a nest of Nomads."

"They're probably long gone," I said.

"But not whatever they fed on," Vse said.

"And they may have left behind broken equipment," Nancy added. She let Lev complete the thought: we might learn a lot from that. Even filings from an unknown alloy could prove useful.

Lev completed the thought and sighed. "Very well. We leave Pluto tomorrow morning. Ah, Igor Petrovich! Welcome back! Do you have the orbital parameters?"

"I do, Captain." The man sat down with us. He looked like the victim of an imaginative practical joke. "I have data on both Nomads, and on seventy-nine Nomads, and on fourteen Nomads.

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Plus other clusters of Nomads too numerous to count."

There was silence throughout the mess area. "Make yourself clear," Lev growled.

Igor Petrovich hesitated. "Sir—I can only *see* two of them, through the telescope. But the radars and other sensors pick up ghosts."

"Jamming," I said. "They don't want us to get a bead on them."

"Jamming is a military tactic," Lev mused. "One uses it only in a war zone."

"Or when you think you're going to be attacked," I said. My hitch in the Army had taught me a lot about tactics, even if I never saw combat, lucky me. "Maybe they're afraid we might try something stupid?"

"When we know they could exterminate us?" Nancy shook her head. "They're afraid of something else."

"Other Nomads," Lev suggested. "Or another race. Perhaps they want the Mercury base for a weapon after all. From what John told me, they could use it as an energy source to power other weapons. And their refusal to discuss why they need the collector—one does not discuss weapons and strategies with outsiders."

"You may be right," Nancy said. Then she shook her head. "No, damn it. What do they have to fight over? Resources? Territory? They've got the whole Universe!"

"Industrial worlds," Lev suggested. "Perhaps different groups of Nomads compete for new industrial worlds."

"By fighting over them?" Nancy said. She shook her head again, so violently that her hair crest swished in the air. "That's wasteful. A species can't last megayears by acting stupid."

And humanity might not last long, either, if assorted aliens slugged it out in the Solar System. I had the good sense not to raise that point, although I didn't take it seriously enough to feel concerned. Besides, I trusted Nancy's judgment implicitly; if she now said a Nomad war was out of the question, she had to be right. I wasn't worried about anything now.

Being in love can do strange things to your head.

After dinner we went to our cabin. "I hope Lev is wrong," Nancy said, as she settled onto the bunk. "But I keep coming back to the idea of a war, too."

"Maybe it's our background," I said. I sat down with her, got an arm around her, and started fooling with her jumpsuit's zipper. Business, hell; I still wanted to get some mileage out of our honeymoon.

"Yeah, background," she agreed. "We're so used to war that it's the first thing to come to mind. The idea punched Wilkes's buttons, didn't it? Only it's getting harder and harder for me to think of another explanation for the Nomads's crisis." She took my hand from the zipper and held it. "They're coming back too soon."

"The Nomads? Too soon for what?"

"Too soon for their own good," Nancy said. "They want a developed marketplace, something that can sell them anything they want, in any quantity they like. Instead they have us. We can barely meet their request, and we have to be told how to do it."

"Good point," I said. When you've wandered for millions of years, what's

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to hurry about? But if you've just lost a battle and have to retreat or regroup, you can't be too fussy about some things. And yet—"I don't think there's a war. The thing I talked to at Correy III didn't say anything to suggest there was one."

"It was over fifty light-years away," Nancy reminded me.

"Which is two months in overdrive," I said, "or almost no time if you talk *via* tachyons. That makes it a next-door neighbor. It would have said something about picking sides, or staying neutral, or *something*. It would have asked me strategic questions."

"Unless it was being secretive. The Nomads know about deducing facts from the questions you ask."

"Maybe." I felt exasperated. Nancy had a stubborn streak as wide—no, wider—than her hair crest. "Wars are bad for business," I suggested. "They waste more than they're worth. The Nomads don't act like their backs are to the wall, and they're too business-minded to fight for anything less than survival."

"So there's no war. Whatever is happening, it's stranger than a war." Nancy sounded reassured. She reached out and scratched me behind an ear. "Now why are we talking about this crap?"

After we got up the next morning Lev announced that we were ready to leave Pluto. While he took the spin off the ship I took Nancy down to the sick bay, where the medbot doped her up against motion sickness. By the time we were ready for the jump Nancy was feeling no pain. She giggled a bit and dozed off.

We were going to be weightless for at least the next day, perhaps longer; first while we repeated the vector-matching stunt, then while we were in t-space, and then while we hunted for a comet. Lev didn't plan to re-spin *Aurora* until we found one, and last night he had suggested that Nancy take a medical vacation. She had jumped at the offer; she didn't need to be up and around, and she'd done enough regurgitation lately.

I went to the rec room and sweated out the vector-matching. We only did it once, dropping our speed from a bit over two miles per second—the sum of our orbital speed around Pluto and Pluto's speed around the Sun—to almost nothing. The engines fired briefly, lining us up, and we went into overdrive.

I now had my first quiet time in many a moon. This gave me the opportunity to contemplate my relationship with Nancy, the problem that was Maya O'Donough, or the multilayered puzzle of the Nomads.

So I'm shallow. I took a breather, shifting my brain into neutral and switching on the cube. A little fiddling got me a vid of the '28 Orbital Olympics—women's gymnastics, naturally. Some people say that weightlessness removes the challenge from the sport, but I think that zero-gee opens up new possibilities. More to the point, weightless gym can be done by full-grown women, while Earthside competition is the province of pre-teen girls.

Guess which group I'd rather watch.

Janie Wehr was giving her gold-medal performance when Vse swam into the rec room. "Akhmetov says we

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will be in t-space in another twelve hours," she said, anchoring herself to a restraint. "But he cannot say how long he'll need to find a comet."

I nodded. "It's a matter of luck," I said. "We'll probably come out within a light-hour of something, but the radars might not detect it. We may have to make several jumps before we hit the jackpot. After that, we'll have to rendezvous with it, which will eat up more time."

"I see." Vse was speaking to me, but her eyes had locked onto the cube. She gronked in horror as Wehr did a double corkscrew.

"Are you all right?" I asked her.

"I am." She tore her eyes from the vid. "It's just—odd—to see a body contort like that."

"I understand." Human and kya skeletons are similar, but the kya have that built-in crouch, which makes some idiots think they're about to leap and attack. As for how they see us, I once overheard one kya tell another that we looked as if a giant had come along, grabbed us by the head and feet, and *pulled*.

I turned the cube off. "Thanks," she said. "I want to ask about the threat Wilkes made. Can she truly send you to jail for discussing science with me?"

"In theory," I admitted, "but it doesn't worry me. If things work out, Resolution 1453 will be a dead letter."

"And if things don't work?" She gestured for silence before I could answer. "Being a severe problem, I've given this much thought. I don't wish to see you in trouble—"

"But you want access to information," I concluded.

"Yes," she said quietly. Then, eagerly: "Being curious, I want to *know!* When I heard the UN was reneging on the treaty, I—it—they—" She squeezed her eyes shut and exhaled in frustration.

"They'll come to their senses," I said.

"One hopes so," Vse said. "But if you have further trouble, you will need help."

I eyed her. "You have something in mind."

She seemed pleased. "Yes. We kya have information you humans will need."

"Huh?"

"Let's say that you humans give us all the information we want. Being prejudiced, I think we will adapt quite nicely, but it *will* create enormous changes in our society. Wouldn't you like to know how to handle it? How we keep from, as Nancy would say, fucking up?"

"Well, the anthropologists and xenologists would . . . " My voice trailed off as I saw the obvious.

How does a world absorb an advanced alien technology without going to pieces? The kya could serve as a test case, and we could learn from their example—and we'll need to learn, because we'll have plenty of trouble absorbing whatever we get from the Nomads.

We've never been good at adapting to technological change. New inventions always catch us flat-footed, and the consequences always include social and political turmoil. You think not? Look at what the Industrial Revolution did to the old European aristocracies, or at what atomic energy did to late twentieth century diplomacy.

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Hell, look at the modern world. Ten years ago there was a thing called the housing industry. Houses were built by hand, out of wood, metal and plastic. Nowadays you sprinkle some microbots over a patch of ground, and watch them reassemble dirt, water and air into a complete structure. Housing costs are one or two percent of what they used to be. So is employment in the housing industry. Few people want to waste money on a custom-made house.

Multiply that upset by hundreds of industries and you have some idea of what the Nomads might offer us. Paradise, but across a sea of chaos.

The UN would dearly love to avoid turmoil. If the kya could help show the Security Council how to keep our world on an even keel, and incidentally keep the UN on top of things, they might find almost any price worthwhile.

"We'll have to talk about this with Nancy," I said. "I don't know how to sell this to the UN, but I'm sure she can think of something."

"Being in their best interest, it should be an easy sale," Vse suggested.

I doubted it. It might be the best thing that ever happened to the UN, but unless they convinced themselves it was so, they'd never accept it. It's a common human failing.

8

The radars pinged away for a few hours after we left t-space, and lo and behold we found a comet. Akhmetov made a jump and a few maneuvers, and that put us within a hundred miles of a giant, dirty snowball.

We couldn't see it. At a distance of thirteen light-months the Sun was just a bright star—and not even dazzling bright; it was only somewhat brighter than Sirius or Canopus. The Sun didn't give enough light for human eyes to see by.

"We are alone," Lev said in grim satisfaction. He turned the radars off. "If the Nomads were ever here, they are long gone."

"Good," I said. Maybe that wasn't the proper scientific spirit, but I wasn't eager to find them. Lev was keeping the overdrive armed and ready; if worse came to worst, he would save his ship. If I happened to be outside—well, no one said us intrepid explorers have it easy.

While Lev spun up the ship I went to the sick bay and woke Nancy. The drugs had worn off hours ago and she was merely sleeping. "Some handsome prince," she said, rubbing her eyes. "You're supposed to wake me with a kiss."

"Not until you brush your teeth, babe."

"Christ, what a romantic." She grimaced. "No, you're right. My mouth tastes like Mom's old band played in it."

We went to the cafeteria, where she started putting away a late breakfast. Halfway through her Belgian waffles she looked at me. "Something's on your mind, John."

I nodded. I had the uneasy feeling that something was about to go wrong, and I knew exactly what it was. "Lev can't find any trace of the Nomads. I don't think that means diddly-squat. What do we do if they show up?"

"Play it by ear. What else can we do?" She paused and looked thoughtful.

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"If they turn up, we'll tell the truth. We're a scientific expedition, investigating cryonic life and a strange neutrino source."

"Is that a good idea?"

"It beats lying," Nancy said. She spoke around a mouthful of waffle. "One problem with lying is that you can get caught. Let's not find out what Nomads do to liars, OK?"

"All right, but what do they do to people who pry into their secrets?"

"I hope they'll be reasonable," she said. "They didn't mind us checking out Correy III, despite their interdiction—but if worse comes to worst, we're expendable. Humanity isn't."

"So if they get pissed, we take our lumps."

"Exactly." She looked at her meal. "I'm not as hungry as I thought I was."

A short while later Vse and I climbed into the lander with two cosmonauts. Larissa Noskova and I were in spacesuits, our belts and backpacks festooned with instruments and collection gear. Vse and Innokenti Grechko would stay in the lander and supervise us—and keep an eye open for company.

We undocked, and *Aurora*'s spin flipped us toward the comet at a leisurely ten miles per hour. Grechko fired a few bursts from the thrusters, notching our speed up to around one hundred MPH. Then he slewed around and focused the instruments on the comet.

Most people think of a comet as an enormous, glowing mass of dust and gas. Any cometary head that comes inside the orbit of Jupiter *will* form a tail, and the tail can grow to a length millions of miles as the comet gets closer to the Sun. That takes energy, however—the heat from the Sun boils the comet, and light pressure and the solar wind blow the dust and ionized gasses into a glorious plume.

Things are different between stars. Here there was no heat to bring the comet to life. The instruments showed something that looked like a baked potato, the size and shape of Manhattan. The detectors said the surface was ice, heavily contaminated by dust and organic chemicals. If there had been light the damned thing still would have been invisible; the surface was flat black, and a better light-absorber than any substance we can make.

"But I detect motion," Larissa said. She squeezed a passable image out of the instruments. "Academician O'Donough, is that a Nomad?"

"No. The shape's all wrong." The item on the screen was built like a thick pizza, with stubby paddles around its rim. I couldn't guess its size. "Have we got a scale on it?"

"Yes. It is five centimeters across." She looked embarrassed. "Then it is far too small to be a Nomad."

"Unless this is a different stage of their life cycle," Vse suggested, "like insect larvae or pupae."

"Party-pooper," I muttered. She might have been right, and accidentally killing a baby Nomad could get us in trouble.

"How could it be a little Nomad?" Grechko asked. With the computer flying the lander he had nothing to do. "Nomads are a highly evolved form of life. Such beings do not leave their young to fend for themselves."

"Not on Kya or Earth," Vse agreed. "But out here? We still have to learn

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what rules apply. Perhaps the Nomads control their population by letting the young fend for themselves."

"Or by abandoning them," I suggested. "The Greeks and Romans abandoned unwanted babies and let them die. Medieval Europeans did that, too—we have a fairy tale about that, called 'Hansel and Gretel.' And other children were abandoned at orphanages and foundling homes. So many kids died in these places that they were called 'angel factories.' "

Grechko looked disgusted. Maybe he'd never heard of such things—most people are ignorant about how our ancestors lived—or maybe he didn't like airing humanity's dirty laundry in front of an alien. He turned back to his instruments, ignoring us.

"Even so," Larissa mused, "why would the Nomads need to control their numbers? They have an infinity of resources, the entire cosmos."

"Which they could fill in a flash," I said, "unless their reproductive rate is impossibly slow."

"A possibility," Larissa said. "If they reproduce only once every thousand years—"

"—then it would have taken them hundreds of eons to evolve from the lower forms, and the Universe isn't old enough for that slow an evolutionary rate to work. So either they practice population control, or they fill the Universe. . . . then die out when they exhaust their food supplies. Which hasn't happened."

She gave up, and I traded a mildly exasperated look with Vse. Look: Larissa was a technician, not a biologist. She saw a Universe which looked infinite, and therefore was big enough for any number of Nomads. Infinity is infinity, right?

Vse and I knew better. Big as it is, the Universe still contains a finite amount of matter. Populations always increase exponentially, until the food runs out or they hit some other limiting factor. Exponential growth means that after a certain point the numbers climb like a rocket, toward disaster—unless you exercise a lot of restraint.

Or unless some other factor is at work. I pushed all that to the back of my mind; I just didn't have enough information to form an opinion.

We kept scanning the comet, and as we drew closer we spotted other, smaller organisms. They all had a vague disc shape, with crude limbs at the edges.

"Bilateral symmetry," Vse said. "I can tell left sides from right. Being weightless, why would they evolve this way?"

"DNA," I said absently, as I watched a yard-wide pancake absorb a lesser creature. "The DNA molecule itself is symmetrical, with a left and right side. Maybe that makes larger symmetries inevitable."

"Like a seed crystal? An interesting thought."

And reassuring, in its way. Whatever force caused bilateral symmetry among planetary life forms seemed to work here as well. It was good to find a familiar natural law in force.

I was tense, all right. Things didn't get better when we touched down on the comet and got ready to go out. As I left the airlock I wanted to look in every direction at once.

Larissa clung to the ladder and started

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scanning with a neutrino detector. While she looked for Nomad doohickeys, I turned on my coldlamp and jetted around on puffs of nitrogen.

The lamp gave off a feeble blue glow, which was more than enough light out here. I couldn't see the perfect black of the comet, but I did catch odd gleams as I drifted along.

The comet had lice. There were tiny organisms here, thumb-sized and smaller, crawling over the ice. The movements were barely perceptible, but a minute or so of steady watching would reveal them. The crawlers left paper-deep tracks along the ice.

I took micrographs of the things, and that was a real bear. I'd focus the instrument on a crawler, and by the time I was set the heat from the digital camera would have vaporized the little beast. I wound up setting the focus at one value, and moving the camera up and down over various specimens. Most of the data I recorded that way was garbage, but I'd get something for my efforts.

The magnetic-resonance imager worked better; at least, none of its red lights came on while I scanned the atomic structures of the crawlers. My next activity was sample collection. I scooped some of the smaller critters into modified Dewar bottles. The things wouldn't live long, but even after they boiled into gas I could analyze them for their chemical compositions.

"I have neutrinos now," Larissa's voice said in my helmet. "Odd, it's a steady pulsing."

"A signal?" Grechko asked.

"Perhaps a beacon," she said. "I can't localize it."

"Don't try," I said. "Get back inside." I was turning back as I spoke.

Larissa demurred. "I see no trouble. This—"

"Do not argue." Akhmetov's voice was loud. "Noskova, return to the lander at once. Grechko, O'Donough is now in command."

"*Which* O'Donough?" he asked plaintively.

"The one with you. John O'Donough."

"Get ready to get us out of here," I told Grechko. Larissa was already at the airlock hatch. I'd have to wait my turn to get back inside. "We may have tripped some sort of alarm. Either that, or—uh oh."

"I see it," Grechko said. "Range, one hundred meters. It's a Nomad."

"Right." It was just barely visible, a black cat in a coal bin. It wasn't wearing a heatshield, not out here, but it did carry several bits of equipment strapped to its naked hide. I had no idea of what those fluted shapes might be.

I persuaded myself it wasn't hostile. My backpack puffed nitrogen as I turned to face it. "We are a scientific expedition," I said. I aimed some of my gear at it, and the green lights told me I was getting good data. "We are here to—hey!"

A tentacle pointed something at me. There was a flash of blue-green light, and I felt heat just above my left knee. I looked down, bending as much as my suit would allow, and saw a charred hole in the white fabric. Air whistled through the hole.

"Grechko, get out of here," I heard myself say, while my hands fumbled for

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the emergency kit. "It just shot me with a laser."

"We can't move," Grechko said. "The airlock is occupied. The safety systems will not permit maneuvers."

"Move as soon as you can." I found a patch and slapped it over the hole. The whistling faded but didn't stop, and I saw the edges of the patch flutter as my air leaked into space.

There was another blue-green flash and one of my instruments shattered. "It's still shooting," I said.

"The weapon does not seem powerful," Vse said.

"Yet one good shot could destroy us," Grechko said.

"It just might." My leg was beginning to hurt, a combination of laser burn and decompression freezing. How long would it be before I ran out of air?

"Grechko," I said. "Switch on all the transmitters and relay this to the Nomad. We are a scientific expedition. We are unarmed. We mean you no harm. Please respond."

"A moment—ready."

I repeated what I'd said. The Nomad replied by shooting me, this time in the elbow. Luck was with me; the reinforced joint held together.

Was it firing warning shots? Maybe we were trespassing. "We are leaving as fast as we can," I said. "Grechko, override the goddamned safeties and get away from the comet." I started jetting away from it myself.

Fat lot of good that did me. The Nomad shot me in the foot, charring my boot. I was suddenly glad it was only using a laser; a bullet might have gone all the way through. "Grechko, is that thing transmitting at all?"

"Negative. We detect nothing, not even neutrinos. Overrides engaged. Maneuvering." Thrusters flared and the lander moved away from the comet.

The Nomad took another crack at me, and a hole flared in a Dewar bottle. I felt a sudden, detached contempt for the alien. Damn it, didn't it know how to kill one lousy human?

I don't know if I was angry or in shock, but I wasn't thinking straight when I decided to ram the son of a bitch. I turned headfirst toward it and hit the thrusters. I held the handle down and built up speed, accelerating at a full twentieth of a gee. I didn't look at the Nomad; I was afraid a lucky shot might catch me in the eyes before I rammed it.

I must have been doing fifteen miles per hour when my suit's computer took over. It sensed that I was on a collision course with the Nomad, and it started slowing me.

The braking thrusters cut off suddenly. "It's gone!" Grechko shouted in relief, making my earphones buzz. "The *yobar* is gone!"

I sneaked a peek. There was no sign of the Nomad. "What happened?"

"It entered t-space," Grechko said. "I don't know why."

"Nitrogen," I said. I turned for the lander. "My thrusters sprayed it with nitrogen gas. The bugger must've felt it was roasting." Nitrogen gas is a whole lot hotter than liquid helium.

I crawled back into the lander. While Grechko headed for the *Aurora* Vse and Larissa extracted me from my ruined suit. My leg looked like hell, but the first aid kit said it was superficial. The

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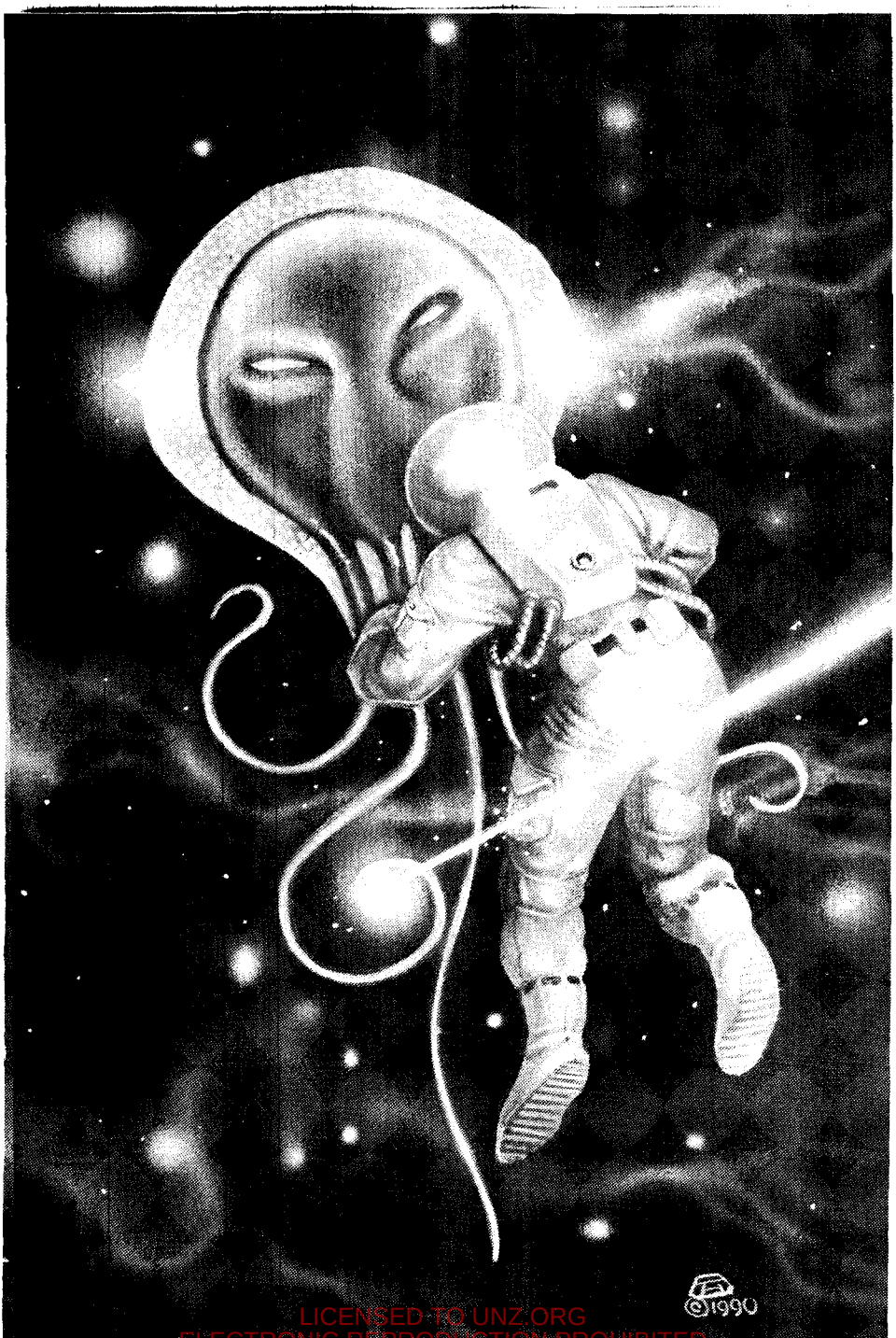

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kit painted it with ointment, then squirted a painkiller and tranquilizer into me.

I'm glad it did that. We were halfway home when something jolted the lander. The lights went out, then came on again as Grechko switched to the emergency batteries. I heard a shuddering hiss, but I was too buzzed to care. "We're losing coolant," Grechko said, scanning his instruments. "Half of our systems are dead."

"I see more Nomads out there," Larissa said.

"Can we return to *Aurora*?" Vse asked.

Grechko shrugged. "An intriguing question. Do not bother me."

We made it back to *Aurora*. The ship had been despun for the docking. Nancy met us at the airlock, valiantly battling her stomach. "Hi, honey, I'm home," I said. My voice sounded hoarse.

Nancy gave me a quick kiss. "Lev wants you on th' bridge," she said. She belched. "We're scramming. Did th' Nomad say anything?"

"Not a thing." We headed for the bridge. The engines fired without warning; Lev was in a hurry.

He had good reason. "There are sixteen Nomads out there," he said as we climbed into the bridge. He pointed to the scope screen, which showed a ragged cluster of Nomads. "That's a visual observation. Oddly enough, radar observations match it. There is no jamming." With Grechko still in the lander, Lev was busy working everything himself. He fed numbers into the computer and we entered t-space. "By the way, John, none of them wore heatshields."

Tranquilized as I was, his faint sarcasm slid right past me. "Are we going to Earth?" I asked.

"We are on course for Tau Ceti. I don't want them to trace us home. We'll emerge into normal space in another six hours; if I'm certain they haven't followed us, we'll turn for home."

"Good." God bless Russian caution. All the theories say that it's impossible to track a ship through t-space. Lev was assuming that the Nomads used a different theory, and if he was right he just might have saved Earth. Perhaps this Nomad flock already knew about Earth, but even so, why give them ideas?

"Now we must discuss the attack," Lev said. "They hit the lander with an unknown weapon."

"Not a laser?" I asked.

"Definitely not," Lev said. "Our instruments detected many peculiar things when you were hit—and at other times. Many shots were fired. It is clear that only their poor aim saved you. Tell me, did you do *anything* to provoke the Nomad?"

"Not consciously. But I wonder—what if that comet was a Nomad hatchery, or something similar? We wouldn't act too reasonable if we found an alien thing in a hospital nursery."

"That won't wash," Nancy said. "We'd at least say something, and —urp—"

"A moment," Lev said. He fired thrusters to spin the ship.

"Thanks," Nancy gasped. She closed her eyes and spoke while gravity returned. "John, it was playing with you . . . cat and mouse. Ev'n after you left th' comet it shot at you. Jus' winged you, too, each time."

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"What are you getting at?" I asked.

"That monster was a sadist."

"You are understandably upset," Lev said, frowning.

"Damned straight," Nancy said. "I'm also *right*. *Think*, Lev. If it was protectin' its young, it would've killed outright. If it was just a lousy shot, it would've closed to point-blank range. Instead it provoked you, John."

"That's crazy," I said. "Nancy, you can't think it *wanted* me to fight! Why would it?"

"It was a sadist," she said. We had gravity again; she opened her eyes and slumped into a chair. "Or a thrill-seeker, or a big-game hunter. Whatever. It was enjoying itself. And—all the other Nomads we know about communicate. These don't."

"Perhaps they have nothing to say," Lev said. He looked gloomy as only a Russian can. "This experience says much about the Nomads. They divide into two factions, one civilized, the other violent . . . and humanity is caught in the middle."

9

"I believe our radar beacons attracted them." Lev said that evening over dinner. We were still in t-space, and all of us were quietly wondering if the Nomads would be waiting for us when we returned to normal space in another hour. "Certainly we did nothing to conceal our presence."

"So they can't find us if we hold the noise down," I said.

"That is the theory," Larissa said. "One hopes it is correct, but I don't feel certain."

"I'm sure of one thing," Nancy said. She looked at Lev. "That comet was no damned nursery. You can't tell me that the Nomads leave their young to fend for themselves, and then show up to protect them from a threat. Those things were hunting *us*."

"I agree." Lev tapped his fork on his tray and raised his voice. "I would gladly return the compliment. Does anyone know which microwave frequencies are absorbed by liquid helium?"

No one knew. "Noskova, ask the computer. Then adjust our comm maser to the proper frequency. We will give our next Nomad a warm greeting!"

That drew a dangerous rumble of agreement as Larissa left the cafeteria. I liked the idea of cooking a Nomad with microwaves, too, but I could see objections. "I'd want to make sure our next Nomad is hostile," I said. "And even then, I'd be careful about zapping it. If the things get the idea we're *too* dangerous—"

"Let them," Lev said impatiently. "I want the power to turn them into smoggy helium, and before God I *will* have that power."

"No," Nancy said. "That's too risky."

Lev's gaze locked onto her. "This is my affair. I will take any steps I feel necessary to defend my ship."

"No." She sounded every bit as implacable as Lev. "You will not take any action which might invite retaliation."

"If we are attacked—"

"You will do your damnedest to evade any attackers." Nancy jabbed a finger at him before he could speak. "Maybe a show of force would deter them. It's more likely they'd decide they had to retaliate with even more force."

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"You cannot know what is likely!" Lev said. The whole cabin was deathly silent.

Nancy nodded once. "Correct. I *don't* know. I don't know what is going on with the Nomads, what sort of weapons they have, or the extent of their numbers, powers and experience. And I don't want to find out the hard way."

Lev remained adamant. "My primary concern is my ship."

"It is not," Nancy said stubbornly. "As long as you are under UN authority, your primary concern is the safety of the human race. You will do nothing to endanger the race. Do you understand your orders, Captain?"

"Yes," he grated.

We were alone in our cabin before Nancy spoke again. "Don't I make a wonderful diplomat?" she asked, her voice sour. "Now I've got the whole crew pissed off at me."

"It's a talent you have," I said. "But you did the right thing—"

"I just did it the wrong goddamned way." She was angry with herself. "I shouldn't have pushed Lev around in front of his crew. I—"

"You should have talked to him in private," I said, "which is impossible here. Then you'd have to gently persuade him not to do something dangerous, and hope it sticks. Nancy, the stakes are too high to worry about manners."

"Like hell. Now he might zap a Nomad just to spite me." She shook her head. "I know. Lev isn't like that. But me—I lost my damned temper. I'm no diplomat."

"You do well enough."

"I just stumble along," she said quietly. "There's too much of my mother in me."

Was there a safe response to that? Look: I knew she had problems with Maya. On the other hand, she still had a strong bond with the woman—if she hadn't, Nancy never would have imitated Maya's old Mohican cut, or kept it all this time. I wondered if Nancy understood that point herself, or if she understood what she felt for her mother. I did know I wasn't going to hurt her feelings by saying anything about Maya.

A safe response? I put my arms around her and held her. "You're doing fine," I said, as she pressed her head against my shoulder. "Just fine."

"Bullshit." After a moment she said, "I ought to apologize to Lev."

"Don't," I said at once. "Apologize now and he'll think you're giving him the go-ahead to shoot. If you've got to do it, wait until we're back on Earth."

"All right." The words came out in a meek voice.

That worried me. On Kya she had absorbed the enmity of two hundred human beings and never missed a stroke. But Nancy had been on the go ever since the Kya Crisis. She hadn't had more than a day's rest in that time, and the strain was telling.

Still and all, she put up a strong front as we went to the bridge. "There's one thing," she told Akhmetov, just before we left t-space. "The Nomads at Pluto jammed your radar. The hostile ones didn't. That's one way to tell the groups apart."

"Yes, yes, of course." He tried to sound impatient, but his voice said he hadn't thought of that. Just the same, we were no longer welcome on his ship.

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Every time Lev glanced at me I got the feeling he was going to make me walk home.

Submariners call it running silent. We left transition space with all of *Aurora*'s transmitters and beacons shut down. Even most of the support and engineering systems were turned off. We radiated the absolute minimum of electromagnetic energy, to make it as hard as possible for the Nomads to spot us.

We drifted between the stars, tumbling and looking through the viewports for any sign of Nomads. In all likelihood our first warning would come from their lasers, or any other weapons they might carry.

"We may have a problem," Larissa said quietly. "The Nomads make great use of neutrinos. Our fusion reactor emits neutrinos."

"Only while operating." Lev's voice was a low rumble. Everyone was keeping their voices low, as if the Nomads might be able to hear us. "At the moment we are using the emergency batteries."

"Good." Larissa looked relieved. Then: "I wonder why these monsters use neutrinos? They're hard to detect, aren't they?"

Lev nodded. "Neutrinos interact with matter only under special circumstances."

"That's probably why the beasts use them," I said. When Lev eyed me I went on, "The Nomads are sensitive to all forms of energy. Heat, light, radio, X-rays, the whole electromagnetic spectrum. Ditto subatomic particles. Exposure to any of that could warm them up and kill them."

"But not neutrinos," Lev said. He nodded grudgingly. "I see."

I was sure he did. Neutrinos pass through most matter like ghosts; you could be irradiated with a massive spray of neutrinos and never even know it. Considering how vulnerable they are to heat, the Nomads must see that as a virtue, one that more than makes up for the obvious difficulty of sensing neutrinos.

After an hour's wait Lev decided we had lost the Nomads. He turned the ship around and set us on course for Earth.

Nancy was tired; she went to bed. I went to the infirmary to have my knee checked. Grechko did that; he was no doctor, but he knew how to run the medbot. "I have examined the lander's damage," he said quietly. He didn't seem comfortable talking with me —Lev's displeasure might have been contagious—but he needed to talk. "The Nomads attacked us with a beam which induces the disintegration of unstable atomic nuclei."

"You use radioactive materials in the lander?" I asked.

"No," Grechko said, "but all materials contain a tiny fraction of radioisotopes, which occur naturally. When the beam struck the number two landing leg it caused those isotopes to decay. There was a sudden release of energy, a miniature atomic explosion."

"It could have been worse," I said. I thought of the things in the human body—carbon-14 and oxygen-18 from cosmic rays, strontium-90 from old A-bomb tests, tritium in the water—and was glad the beam hadn't hit us. Maybe it wasn't a proper weapon; I decided it was a tool, pressed into service as a

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weapon, and not easy to aim at a small target.

"This disintegrator could devastate Earth," Grechko said. "Play the beam across a nuclear-waste site, or an old reactor, and the detonations would rival fusion bombs. Worse, there are veins of radioactive ores throughout the planet, a hundred kilos of uranium in every cubic kilometer of sea water, traces of uranium and thorium in granite mountains—"

"I get the idea," I said, chilled. "Innokenti Ilich, I sincerely hope the Nomads are not following this ship."

"As do I." He looked me over. "It might be healthier to incur Captain Akhmetov's wrath."

"Perhaps." But I was in a position to know, and I wasn't sure about that.

10

Lev wouldn't accept an apology.

"It isn't because you were rude," I told Nancy as we crossed the UN's flight plaza. My leg was healing nicely, thank you, and I was barely limping. "It's because you were right—"

"—and I made him look bad," she said angrily. "It still isn't fair."

"I know." Lev had been a friend, and in time he might have become a close friend. Nancy had pulled rank on him, turning him into a subordinate aboard his own ship. That was something he couldn't forgive.

Aurora's lander lifted off as Nancy, Vse, and I entered the Secretariat Building. Vse went to see her ambassador while Nancy and I went to Wilkes's office. We'd received orders to report to her while *Aurora* was entering Earth orbit.

I wasn't looking forward to this. My last "debriefing" had been something out of a bad movie. As for Nancy—she was tired. Instead of putting bags under her eyes, exhaustion made her cranky, and I sensed that she was spoiling for a fight.

Wilkes was in her office with four other people. "You two are late," she said curtly. "Well, sit down, we have work to do." She snapped her fingers and a couple of chairs rolled up to the desk.

Wilkes spoke to Nancy as we took our seats. "The secretary-general has given this committee a simple assignment," she said. "It is clear there will be a battle, and the Mercury power collector will figure in it. This makes the inner Solar System, including Earth, a target. Therefore we are to develop a strategy to persuade the Nomads to leave Earth alone."

"Which Nomads?" Nancy asked. "There appear to be two groups—"

"The Timids." The way she said it, I knew the word had a capital letter. "The ones at Pluto. Wu, fill her in."

A youngish Chinese man spoke up. "The Nomads at Pluto show all the signs of having lost a major battle, perhaps even a war. They are timid, desperate; they utilize countermeasures and secrecy even when there is no need. We conclude that they plan to make their last stand in the Solar System.

"The other Nomads, designated the Bolds, behave like winners. They do not hide; they are daring and aggressive. They—"

"They attacked our expedition," Nancy said.

"Our analysis says the attack was an

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error," Wu continued smoothly. "The behavior which you characterized as sadistic was meant to disable Dr. O'Donough, to permit his capture and later interrogation—"

"Bullshit," I said, surprising myself—but that was obvious nonsense. "What jackass came up with that crock?"

Wilkes tsk-tsked me. "Doctor, you're upset because that Nomad shot you."

"That doesn't answer my questions." I jabbed a finger at Wu. "Well?"

He looked angry. "The Nomads are alien, and thus not entirely comprehensible—"

"Double talk!" I snapped. "You're saying you can understand them when it's convenient, and anything that contradicts you doesn't count—"

"You have no grounds to accuse us—"

"Shut up, both of you!" Wilkes said. "Doctor, this analysis was done by the general staff of the Peacekeeping Forces, and I see no reason to question our experts."

Experts, my butt—the general staff is a ceremonial body, and its members are chosen for political reasons. The real military brains stay in their native countries, because their governments don't want to give the UN any significant military power—and military talent is power. Ask Napoleon, or Julius Caesar.

"Let's get two things straight," Nancy said. "First, you've decided the Nomads are fighting a war."

"The conclusion is inescapable," Wilkes said stiffly. "And as I recall, *you* first suggested it."

"I was wrong," Nancy said. "There still aren't enough facts—"

"Perhaps *you* lack all the facts," Wu said. "*We* are convinced there is a war."

Nancy ignored him. "Second, you've decided the human race has to side with the winners, so we're going to stick it to the other side."

A woman at the desk scowled. She was a bit older than Wilkes, and so black that her skin looked almost purple. She spoke with a Zululander accent. "That is crude, but concise. You, an American, cannot appreciate such a necessity. To side with the losers is a grim prospect."

She had a point. Before southern Africa stabilized in the Twenties it was a hell brew of civil wars and despots. Anyone with the poor sense to have backed his conqueror's enemies was liable to wind up dead. We Americans have had it soft for centuries; we've always worked from a position of strength, so we've never had to learn how to roll with the punches.

"I don't have some romantic need to back the losers," Nancy told the woman. "Right now, I can't even say who the losers *are*, or what they might be losing. But I do know this. The Nomads at Pluto told us to butt out—"

"An inevitable command," the Zululander said. "But one they cannot enforce."

"Don't count on that," Nancy said impatiently. "Now, the Nomads who attacked us are already hostile to humanity, so we *can't* side with them. Hell, they won't even *talk*, so you can't negotiate with them."

"We've read your report." Wilkes sounded kind. "And we can understand your feelings—they attacked your husband. However—"

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"—your orders are to find a way to persuade the Nomads to leave us alone." Nancy spoke in a low voice. "My advice is that you forget it. Neither side will listen, and we don't have any way to enforce our wishes. Our best bet is to stick with the Nomads at Pluto—"

"We'll note that in our report," Wilkes said.

Nancy raised an eyebrow. "Note this, too. The Bolds act like pirates, not Nomads. We know that the Nomads depend on trade, business. The Bolds must be an outlaw minority, and if we back them, we're dead. The majority of the Nomads will decide we're too dangerous, or stupid, to be allowed to live."

"Noted," Wilkes said. She looked thoughtful—or calculating. "It's one possible interpretation, although we've discarded it. Our *immediate* concern—"

"My immediate concern is rest." Nancy ran a hand over her eyes. "I'm taking a leave of absence, effective at once."

There was consternation around the desk. "We truly require your assistance," Wilkes said.

"You heard what I said," Nancy told her. Her hand touched my elbow and we stood up. "And what John said. Clip it on as an addendum, or put it under a separate cover. Right now I'm too tired to think straight."

"Where do we go now?" I asked her, after we left Wilkes's office. I was worried. She had to be half-dead with exhaustion to give up without a fight.

"We go somewhere quiet," she said. "I've had enough crap for now."

"Ditto. That committee has already decided what to report."

Nancy chuckled quietly. "Tell me something I don't know. They didn't care what I said—they just wanted my name on the report. For verisimilitude. So it'd look like I approved. But it's not just them. The security council has made its decision; the committee is just gilding the lily."

"I know. Nancy, are they crazy? They know what the Nomads said. How can they misinterpret it?"

"I don't know," she admitted. "There must be something in the decision process that we don't know about. They've got the same facts we have, but they've come to a different conclusion."

"They couldn't have talked to a good sociologist," I kvetched.

"Maybe they did," Nancy said. "We have differences of opinion over what things mean. Maybe they picked someone whose opinions agreed with theirs. I dunno."

We stepped into an elevator. "Parking lot," she told it, and we headed for the roof. Once there she paged a limo, and while we waited for it I suggested assorted vacation spots for her leave. None of them drew her interest, and she finally waved a hand. "Surprise me, John."

I was the one who got the surprise. After the limo arrived—one of her father's cars, and certified bugproof—she told it to take us to the Orbidyne offices. "You're not thinking about space?" I asked as we took off.

She shuddered. "God, no. I want to see Mr. D. You can guess what the UN will do next."

"Cancel the power collector."

"They're all so goddamned clever," she said, leaning against me as the car

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turned. "So we've got to be more clever. We can't do a damned thing about the Nomads, but we *can* try to keep the UN from blowing it." Nancy sighed. "So tired. When this mess is over—"

"There'll be another crisis," I said. "And you'll jump into it, like the idiot you are. The only way you'll stop is if I chain you to a wall."

"Promises, promises. Listen, big boy, I'll take it easy after I talk with Mr. D. OK?"

"OK." She snuggled her head against my shoulder. "Nancy? What do you think is happening?"

"With the Nomads?" She sighed. "I can't say. My imagination is squeezed dry. But the UN wants to think it's a war. That's the easiest concept for them to grasp. Question is, what do we do now?" She yawned. "At least Wilkes thinks I'm too bushed to make any trouble, so she won't watch me for a while. That'll come in handy. . . ." She dozed off.

That left me alone with my thoughts.

War. Was Nancy just being stubborn when she claimed the Nomads weren't fighting a war? I decided she wasn't; she knew better than to fight the facts.

Something about the attack nagged at me. The outlaws should have chopped us to pieces, but we got away almost unscathed. Their marksmanship stank, and they hadn't shown any sense of tactics. That loose cluster Lev had spotted—I'm no tactician, but I did learn a few things in the service. The most important was that a combat unit is a team.

You can recognize a team just by watching it. In battle, the team members cover and support one another, and their movements are coordinated; if they don't, they get wiped out. That's true whether we're talking about infantry, battleships or fighter aerodynes. The renegades had looked like an undisciplined rabble, however, and their gunnery said they'd never had any serious target practice. Whatever they were, they weren't soldiers.

Too bad that didn't tell me what they were.

After a while the car entered Camden and parked itself on the roof above Dowling's office; we'd been cleared to use it instead of the main parking area. Dowling himself came out to greet us. "I just got a call from the secretary-general," he said. "I'm supposed to stop working on the collector."

"I'm not surprised," Nancy said as we went down a flight of stairs. "But are you going to obey?"

"I don't know." The stairs opened into a small lounge. He poured coffee for us—the lounge was equipped to make hand-brewed coffee—and served it on a tray. "Legally, I *could* ignore the order, but there are other considerations that can stop me."

"Money," I said.

"That's the big one," he said. "This collector is expensive—microbot design and programming; transportation—we can just barely maintain workers on Mercury; organization—" he threw up his hands"—if the UN doesn't fund it. I can't build it."

Nancy looked at him over her coffee. "What about the Nomad data, Mr. D.? Won't that pay you back?"

He shrugged. "Without knowing what it is, how can I say? I don't doubt it'll be valuable—but will it pay any profits

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this quarter? What are the projected earnings? That's all the board of directors cares about, and if I risk bankruptcy they'll fire me."

"Could you cut a deal with Glavkosmos or Eurospace?" I asked.

"I could, but the UN could make trouble for me," Dowling said. "Block contracts, impose sanctions—"

"Tell them you're keeping humanity's options open." Nancy suggested. "Mr. D., something strange is happening with the Nomads. We were attacked—"

Coffee sloshed from his cup. "What!"

"—by a small group of outlaws," Nancy said. "The way I see it, either we cooperate with the Nomads at Pluto, or we die."

"That . . . " Dowling stared into his coffee for a long moment, ignoring the servitor that dabbed at his spill. "We may die if we cooperate. The power collector—I know how it works now."

"Does it matter?" Nancy asked.

"Very much," Dowling said. He looked us over. "Do either of you know much about polarization?"

Nancy shook her head while I spoke. "Photons have wave characteristics. When light is polarized, the waves are all aligned with one another, vibrating in the same plane."

"Good enough," Dowling said. "You can polarize light several ways—bounce a light beam off a pile of glass plates, and the reflected beam is polarized. A strong magnetic field can polarize light. Or you can shine the beam through a sheet of Polaroid."

"Is that the stuff they use in sunglasses?" Nancy asked.

"It is," Dowling said. "It kills glare by polarizing the light. Polaroid itself is a kind of plastic with very long molecules stretched into parallel lines, like a picket fence." He put down his coffee cup and held up his left hand, spreading the fingers. He slid his right index finger up and down between a gap. "When a photon is vibrating in this plane, up and down, it can pass. But when it's vibrating sideways—" He moved his finger left and right, knocking it against the other fingers.

"It can't get through," Nancy said. "It's like it hits the fence posts."

"Close enough," Dowling said. "So we pass a beam of light through our polaroid, and it gets polarized. Now, when we pass it through a second sheet, one with its 'picket fence' at a right angle to the first—"

"All the light gets absorbed." I said.

"Yeah. That's how the collector works. It sets up hundreds of spherical magnetic fields, nestled one inside the other. The first field polarizes light and all other electromagnetic energy. The second field absorbs it—don't ask me how, my physicists still don't believe it's possible—and transmits it to the gear on Mercury. The next hundred fields are aligned at different angles, so all the energy is trapped. It's efficient," he added.

"So what's the problem?" I asked. I hadn't spotted it—but Nancy's jaw had dropped.

"The field surrounds the *entire Sun*," Dowling said. "The instant they turn it on, it'll absorb all of the Sun's output. Even if they only set the thing to tap a fraction of the Sun's output—"

"—Earth will freeze," Nancy concluded.

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Dowling nodded. "It just might. I'm not sure that's much better than anything else that might happen."

"That's only if they leave it on continuously," I said. "Over a period of days, or weeks."

"A distinct possibility," Dowling said. His face showed anger and disgust. "But, damn it, we have to gamble that they won't. I'll build the damned thing, because if I don't our friends at Pluto will exterminate us, won't they?"

"I'd count on it," Nancy said. "The UN may not want to believe it—"

"—but we can't take the risk." Dowling tasted his coffee and grimaced. "It's easy to make a decision when you have no options."

"It is," I said. I could almost sympathize with the UN. The best thing for Earth would be if both groups of Nomads just went away; the alternatives all stank, in varying degrees.

I said, "Almost." The Nomads wouldn't go away. I don't know what might be our best move, but I knew we had to avoid the obvious blunders, even if they looked like they could get the results we wanted.

"I can pull some other corporations into this." I could see the calculations going on in his head. "I can palm the collector off as something *we* can use. We could tap a thousandth of the Sun's output, and have all the energy we can use—and not decrease the solar flux enough to harm Earth. Bringing in Glavkosmos and Eurospace, and maybe Nippon and Long March, has advantages. If everyone has a piece of the pie, the security council is going to find it hard to stop this."

"That sounds good," Nancy said.

"If it works," I said.

"We can show a profit," Dowling said. "That always works." ■

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Dr. J. Kevin Steele

NEW HOPES FOR A VERY OLD DISEASE: CANCER THERAPIES FOR THE 1990s

The discovery that "germs cause disease" was a medical milestone. The mechanisms for some very important diseases are a lot more complicated but it seems they can be understood and dealt with.

INTRODUCTION

The history of cancer on Earth is very old. The remains of Coal-Age dinosaurs brought down by the disease have been found, mostly victims of cancers of the bone, which were readily preserved in the fossil record. Those bone cancers known as osteomas, and hemangiomas of the vertebrae (either causes an extremely painful death, judging by modern victims) are representative of these most ancient recorded cancers. The remains of Pleistocene cave bears who died a horrible death from osteogenic sarcomas of the hipbones have also been found, their remains curled up in abject misery among the cave-paintings of Early Man revering them as immortal gods. Among humans, the disease can be traced back 5,000 years to the Pharaohs of Egypt; mummies of kings and queens killed by sarcomas, and at least three killed by malignant nasal-pharyngeal carcinomas (these destroyed the facial features before burrowing into the skull to mercifully bring death) have been documented.

In our own day, the course of cancer seems to run unchecked. There were a million new cases in the US this year, and 500,000 people died of the disease. One in three deaths in America are now caused by cancer, a rate second only to heart disease, and over thirty times the rate of death from all the infectious diseases (including AIDS) combined. Worse, the relative chance an individual has of dying from cancer has been accelerating upward, from 151 deaths per 100,000 people in the 1950s to 188 in the decade of the 1980s. The costs for treating this army of sufferers are bounding upwards as well, from 10.8 billion dollars in 1980, to 23.0 billion

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for 1986, easily exceeding, for example, NASA's entire budget for the same period.

Clearly, the conventional therapies in use so far, such as chemotherapy, radiation, and surgery, have not overall been a very successful approach to the treatment of the disease. For the sake of comparison, let's look at another disease for which an effective therapy has been found—tuberculosis. This disease once killed 75,000 Americans a year, and, at one point, the disease was the most frequent cause of death among persons aged 15 to 45 years. Like cancer, low-income groups, minorities, and native Americans suffered a far higher incidence of the disease than white Americans and, again like cancer, different strains of the disease manifested different degrees of invasiveness, or ability to spread throughout a victim's body. It was one of the most common causes of death in the world. That was the situation until 1956. In that year, a vaccine was introduced, and by 1957, the WHO (World Health Organization of the UN) had vaccinated millions of people. An effective chemotherapy was developed, consisting of three chemicals: streptomycin, PAS, and INA, used in concert to prevent development of resistance. Today, the incidence of tuberculosis has fallen until it causes only a fraction of 1% of all deaths in the US, and the worldwide incidence has plummeted. This, then, provides an example of a disease that has been cured (or at least effectively managed).

Now, take the case of cancer. Here, the mortality rate for the disease has risen 25% since 1962, and the overall rate of incidence has risen 13%, even adjusting for an aging population (cancer preferentially strikes the elderly). Thus, it is immediately clear that cancer represents an example of a disease that is not cured, despite the self-serving attempts of numerous institutions to claim otherwise. In fact, mortality rates attributed to the disease have not changed dramatically since the 1950s(!). Often in cases where claims have been made for slow but steady progress in the treatment of certain cancers, the reality is that any changes in mortality are related to factors other than a more effective treatment. An example of this type of cancer is prostate cancer, whose 5-year mortality rate has been apparently falling for the past 30 years, from 63 to 43 percent. However, this represents a change in statistics, rather than medicine; a vigorous program of detection has lead to the discovery of many tumors that would never have become clinically apparent, and this, coupled with the discovery of latent tumors in patients who died of other causes, has lead to an increase in the number of prostatic tumors reported. With the number of "cases" greatly increased and the mortality rate unchanged, the relative death rate decreases, and this becomes the justification for the slow and steady progress claimed. In fact, as clinical trials can easily demonstrate, the cure rate for this cancer has remained essentially unchanged since the introduction of hormone therapy in the 1940s. This singular lack of progress is the case with most important cancers;

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and, while there have been notable exceptions, such as effective therapies for childhood leukemia, Hodgkin's lymphoma, and B-cell lymphomas (all have proven susceptible to available chemotherapy), these represent the smallest proportion of mortality attributable to cancer. Those victims of "The Big Three" of Cancer—breast, lung, and colon tumors—have seen little or no improvement in their prognosis since the 1950s.

Enough doom. There are now new therapies standing on the horizon that would have been impossible to predict even a decade ago. They will revolutionize cancer therapy the way it should be done, as it was done with tuberculosis—with crashing death rates and evaporating rates of incidence, not statistical manipulations. There follow four general approaches that represent therapies of this type, and all of them have this in common: they represent approaches that will be effective against all forms of cancer: a pan-cancer cure.

A. Angiogenesis Inhibition Therapy (AIT)

Angiogenesis refers to the process whereby the blood vessels of the body are formed, usually to accommodate growing tissue during youth, or to aid in wound repair in the adult. Some aspects of this process are still mysterious, but it is clear that the cells that lay down the new blood vessels (called endothelial cells) are directed and stimulated by factors called Angiogenesis Stimulating Factors. ASFs are released by normal cells involved in the repair or growth of the body and, under their influence, endotheliai cells start a branch from a main vessel near the wound or growth site, and extend it until the area requiring blood is well supplied with vessels.

Cancer cells, as they undergo their unrestrained growth, have a great limitation: they cannot produce the blood vessels necessary for their survival. The growing tumor must therefore try to trick the body into providing them. The center of nearly any solid tumor has no vessels supplying it, and starves for lack of food and oxygen. This process of wide-spread death in the tumor center is already underway when the tumor is as small as a few millimeters wide. It is at this point that the cancer must be successful in recruiting the body's help in providing it with blood vessels, or it will shrivel and die. It does so by producing ASFs, thus stimulating endothelial cell migration and the laying down of fresh vessels to provide it with a supply of blood. Some cancers are better than others at this, and those young cancers that cannot produce ASF molecules will die at this point, be reabsorbed, and likely never be noticed by their human host. For those cancers which survive, the need for fresh blood vessels only becomes more acute as the tumor grows; within the bulk of the cancer there remains a center starved for oxygen and nutrients while the outer layer is constantly engaged in scavenging fresh blood vessels, vampire-like.

Here, then, is a situation that makes the cancer vulnerable to a therapeutic attack. The tumor must manufacture ASF recognizable to the host body, and

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there are a limited family of ASF proteins which have recently been purified and characterized. Monoclonal antibodies (antibodies which are very specific, and can be made in bulk) have been made to some of them, and the rest will not be long in coming. A therapy that would block cancer growth through stopping its ability to recruit blood vessels thus becomes easy to visualize. Antibodies specific for the ASF utilized by the tumor will be given to the patient, and these will then circulate, seek out, and deactivate the ASF molecules required by the tumor to survive. The result, as shown in Figure 1, is the hypoxia-induced death of cancer. The advantages of this system are clear;

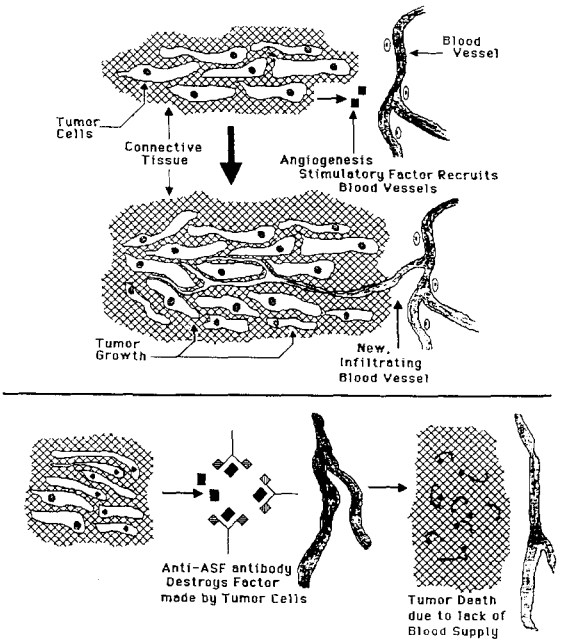
Blood Vessel
Tumor Cells
Connective Tissue
Angiogenesis Stimulatory Factor Recruits Blood Vessels
Tumor Growth
New, Infiltrating Blood Vessel
Anti-ASF antibody Destroys Factor made by Tumor Cells
Tumor Death due to lack of Blood Supply

Figure One - Angiogenesis Inhibition Therapy.

Cancer cells pass through an early critical period in their development, in which they must be successful in luring the endothelial cells of the body into producing blood vessels for them. In the upper panel, a successful tumor produces the angiogenesis stimulating factor (ASF) required to bring this about, and thrives. The lower panel shows the result of blocking these signals with a specific antibody against ASF; no blood vessels are recruited, and the tumor dies in hypoxia.

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since all humans use the same ASF proteins, this cure would be effective for all solid tumor cancers, including tumors of the lung, colon and breast. Additionally, the tumor would have no means by which to generate resistance to the therapy, since any tumor-directed changes rendered to the ASF molecule, which could cause it to be invisible to the antibody, would also render it inert and useless in recruiting endothelial cells.

A problem with this sort of therapy might be a certain incompatibility with other conventional medical procedures. During the course of treatment, the patient's own ability to form new blood vessels would probably be impaired, which could lead to problems if wound repair, such as after surgery, were required. It would, however, be a particularly powerful approach to blocking metastatitic cancer colonies from taking root in new locations after the primary cancer had been removed. These colonies cause the majority of mortalities in operable cancer cases.

B. Differentiation Factor Therapy (DFT)

Every cell in the body achieves its eventual mature state by passing through a series of intermediate, immature states. Before it matures, any given cell can have many possible destinies; the youngest type of cell, called the stem cell, can potentially become any cell of the body. As the cell passes through each additional stage of maturity, the process of differentiation is one-way and the options open to the developing cell steadily decrease. The path each cell takes can be thought of as the branches of a tree; at each junction the cell moves closer to its final mature form, and many other possible destinies are then closed to it. At the end of the maturation process finished, mature cells are formed; these might be blood cells or skin cells or intestinal epithelial cells, depending upon which series of branches the cell followed.

The maturing cells are pushed along the various pathways by chemical signals called Differentiation Factors (DFs) that are released by regulatory cells. A schematic pathway is shown in Figure 2. DFs stimulate the cell to move along its appropriate pathway and effectively block the return journey, and each DF is responsible for moving each cell one step along the process.

So it goes normally. However, cancer cells represent a kind of cell that has returned to, or never left, a primitive stage in which it has very few characteristics in common with mature cells, which exhibit slow growth rate, perform useful functions, and divide only when ordered to do so. Instead, the cancer cell performs no function, divides at will, and has failed to differentiate into any sort of useful cell. To demonstrate how bizarre this can get, there is a type of cancer called teratocarcinoma that starts existence as a mature cell, then reverts back to a primitive immature cell, grows uncontrollably and then often differentiates back into a different type of mature cell. This can take on truly weird aspects, as fingers, hair, and other body parts can form at the site of the cancer,

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frequently within the abdomen.

Given all this, a very powerful approach to rendering cancer harmless would be to force it to differentiate from its rapacious, immature form to a harmless adult cell. Applying the appropriate DFs would be the mechanism that would make this possible. Isolating and characterizing the DF molecules of the body has been an immense challenge that is just now being accomplished. Once all the major DFs have been identified, applying the appropriate signals to the center in question should bring about the conversion to a harmless state (Figure 2).

Work on this approach is already under way. For example, human promye-

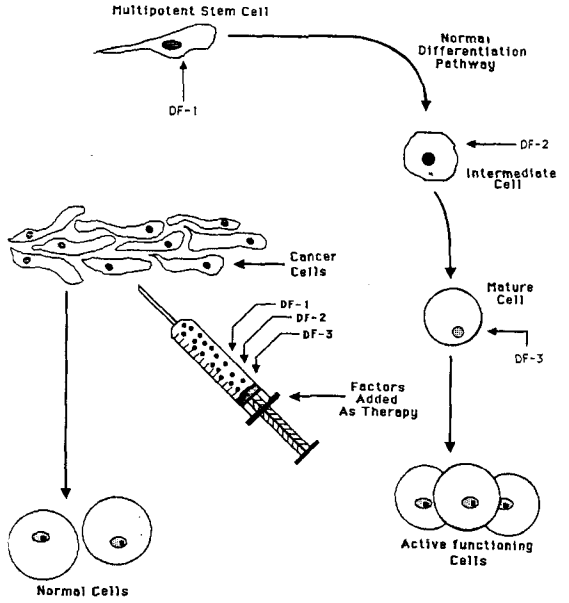

Figure Two - Differentiation Factor Therapy.

Normal cells move from the immature to a mature state along a pathway driven by various differentiation factors produced by the body's regulatory cells. Each DF pushes the cell along one stage of the journey, which is one-way for the normal cell. Cancer cells represent a population of cells which have never matured, or have reverted to a primitive state of rapid, useless division. Applying the appropriate DF to the tumor cells, in the quantity and order required, is proving effective at converting formerly rapacious cancers into quiet, mature cells.

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locytic leukemia cells will, if treated with the DF known as retinoic acid, convert themselves to harmless granulocytes. These new cells, formerly a deadly cancer, can now even perform all the useful functions of granulocytic cells; they can bind antibodies, phagocytose (eat) bacteria, produce bacteriocidal superoxides, etc. Using a different DF propels these same leukemia cells along a different pathway, ending at the mature cell type called macrophages, whose normal function is to patrol against bacteria. Similarly, myeloid leukemia cells can be converted to quiescent mature cells by the addition of G-CSF, another differentiation factor.

This therapy lends itself particularly well to the treatment of leukemias and lymphomas, which are the classic examples of fast-dividing immature cells that have failed to differentiate. Potentially, though, all types of cancers could respond to this kind of therapy. For therapeutic purposes, it would be required to first stockpile all the appropriate DFs. For each patient, the general category of each tumor would be identified, and the conversion of the cells to a mature form with the required DF could be undertaken. Surgery might be necessary to remove the residual immature tissue that remained at the former site of the cancer after conversion to mature cells took place.

C. Suppression Deletion Therapy

In addition to ignoring the instructions of the body while forcing its cooperation in providing food, the successful cancer must also perform another task: it must evade attacks from the host's immune system. It seems clear that virtually all cancers are recognized as foreign invaders by the body's immune system, but at least in those cases of cancer that become clinically apparent, this attack comes to nothing. Accordingly, the mechanism through which the cancer succeeds in blocking the immune system has long been an intriguing question. Non-specific blocking of immune function has been hypothesized to occur in two separate ways. First, the tumors might produce substances that poison the immune system; such blocking substances might be similar to the prostaglandins, which are small immunosuppressive molecules. Second, another idea holds that the cancer becomes a huge drain on the resources of the body, consuming so much protein that the formation of antibodies and other immune substances becomes seriously impaired.

Neither of these possibilities seems likely, however; and this can be demonstrated by a relatively simple experiment. It is well known that cancers from one individual cannot be transplanted to another, since the cancer tissue is seen as foreign by the recipient's immune system and rejected in a manner analogous to organ transplant rejection. If a cancer relied primarily on poisoning the immune system, then cancers transplanted from one mouse to another of a different strain (for example) should grow if enough of a cancer burden, say 100 million cells, were imposed. Once transplanted, the new host's immune system requires a full week to recognize

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the cancer cells as foreign and become activated, more than enough time for the cancer to become a drain on available protein reserves, or to release various immune poisons. In fact, when this experiment is performed, the results show rapid and complete destruction of the transplanted tumor every time.

So if the immune system is not blocked in this way, how does the cancer do it? Here the successful cancer is almost malevolently calculating. It makes use of a population of normal cells, called T-suppressor cells, that function to suppress the immune system in the normal course of events: these cells slow down and dampen out an immune response after an infection is over, and they function to block the immune system from attacking the ordinary cells of the body during development. As such, they are a normal controlling element of the immune system, designed to keep it from running wild. Successful cancers essentially convince T-suppressor cells that they are normal tissue, and, once enlisted to the cause, T-suppressors cells will then stand guard over the developing tumor, and block any attempts by the immune system to attack it (Figure 3). They also release specialized factors, called T-suppressor factors, that

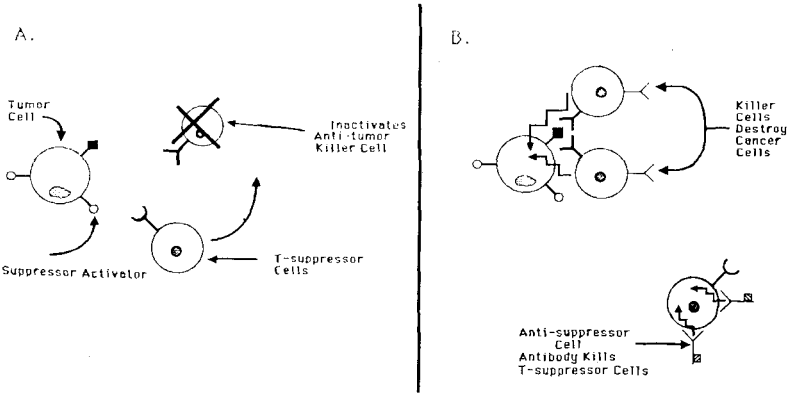

Figure Three - Suppression Deletion Therapy.

Tumor cells normally would come under fire from the host's immune system, in the form of cancer-specific killer T-cells (upper panel). However, the cancers which are successful in growing in their host possess cell surface markers which can stimulate immune system regulating cells called T-suppressor cells. These cells then produce factors which block the action of the killer cells, and the tumor is free to grow. Utilization of antibodies which can destroy the suppressor cells (lower panel), and block the suppressor factor, removes the restraints from the killer cells, which can then obliterate the tumor.

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circulate throughout the body to block any attempts by the body to interfere with newly founded cancer colonies. Here again, as was the case for angiogenesis, the cancer has usurped normal cells to ensure its survival. Under the influence of the growing expanding tumor, suppressor cells, which are normally fairly rare in the body, increase greatly in numbers, settling down in the spleen and thymus to block new immune responses from getting underway.

However, this renegade population of suppressor cells shielding the cancer provides researchers with another cure that would be pan-effective: deleting the suppressor cells in order to expose the cancer to immune system attack. This could be accomplished by treating the patient with a monoclonal antibody specific for suppressor cells. The antibody, when coupled to a toxin, will bind to the target suppressor cell (Figure 3), delivering the poison directly and fatally. Their removal makes the cancer vulnerable to immune attacks, and the cancer is promptly rejected. Experiments of this type have already been performed in mice with greatly advanced cancers, and total regression of the tumor was often the result, even in mice near death. An antibody that can bind to human suppressor cells has now been made, and could be expected to be as effective.

The advantage of this system is its wide applicability, in that recruitment of suppression is essential to the survival of nearly every cancer studied. Additionally, while all cancers express different cell surface proteins, and thus cannot be attacked effectively with antibodies and toxins (this was attempted a great deal in the 1980s) all suppressor cells, regardless of the individual they come from, or the cancer they are protecting, have exactly the same targets for antibody killing, making the procedure effective against all forms of cancer.

D. Towards a Vaccine for Cancer

It is said that an ounce of prevention is worth a pound of cure, and certainly a vaccine that could protect the population from the risk of acquiring cancer would be welcome, to say the least; it would also represent our final triumph over the disease. However, in order to vaccinate successfully against a disease, you need to know the causative organism or agent involved. The origins of cancer in the human animal are complex, and the length of time required before cause becomes effect can be twenty years or more. Many substances have been blamed for causing cancer, more every day, until one is reminded of Mark Clifton's "The Dread Tomato Addiction" (*Analog*, 1958), in which the author reminds us of the fatal nature of tomatoes (and of the problems inherent in epidemiological studies) by pointing out the 84% percent of traffic fatalities involve people who have eaten a tomato, and that, in addition, 100% of people born before 1800, and who have eaten tomatoes, are now dead. The study of cancer epidemiology is certainly equally confused, and is, because of the time lag involved, necessarily more complex than the study of diseases

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with bacterial or viral origins.

The implication of viruses as a cause for cancer, separate from chemicals or radiation, occurred quite early in cancer research and has remained a subject of intense research. The hope has always been that, if a family of viruses acting in concert with chemical toxins, radiation, or other risk factors were intimately involved in the transformation process, then it should be possible to immunize the population against these viruses, and eliminate cancer.

The evidence linking viruses to cancer is, in fact, very extensive. In the 1930s, Peyton Rous, demonstrated that certain tumors in rabbits were caused by viruses. These observations were expanded in the decades to follow as avian tumor viruses (the cause of leukemia-like diseases in chickens) and mouse breast cancer viruses were discovered. Viruses that cause sarcomas—deep solid tumors of the muscle—were discovered in the 1950s. These observations were capped in 1957, when Stewart and Eddy announced the discovery of the polyoma virus. This same virus was found to be the cause of mesothelioma, mammary cancer, parotid tumors, metastatic osteogenic sarcoma, endothelial tumors, lesions of the kidney tubules, and even hair follicle tumors! During the 1960s, the discovery of radiation-induced leukemia viruses and adenoviruses completed the list. The latter, described by Trentin and Taylor, were particularly interesting; human adenovirus injected into a guinea pig, for example, would invariably cause malignant tumors at the site of injection. This showed that susceptibility to cancer-causing viruses could cross from one species to another.

How the cancer viruses bring about their transformation is now well known: when these viruses first enter the cell, they insert their DNA into the DNA of the host cell, where it remains until something triggers it to come out of hiding. This signal is probably a chemical or radioactive insult, a point to which we will return. The viral DNA then loops out of the cellular DNA, often taking a few cellular genes along with it in the process. The cell's genes are packaged along with those of the virus in the forming virus particle, and are transported to the next cell the virus infects. There, the virus again integrates into the DNA of the host and again hides. The cell DNA it has hijacked does the same, and at that point, depending on where it has integrated into the new cell's DNA, is when the trouble starts.

If the transported cellular gene codes for growth factors or some other activating protein or signal, and it finds itself in an active stretch of DNA, then, lacking the controls that once blocked it from being read unless absolutely required the gene will begin to direct the production of huge quantities of unwanted growth factor. These factors will trigger a cascade of events that lead to the cell turning cancerous, and the new gene is thus termed an oncogene (onco = cancer).

Many tumors have now been shown to be caused by oncogenes. For example, the adenoviruses can carry an on-

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cogene called EIA, which produces a product leading to retinoblastomas (a tumor of the eye that accounts for 10,000 cases in the US) in humans; small cell lung cancers are caused by the growth factor bombesin, which is coded for by an oncogene carried into the cell by a virus. Leukemias and sarcomas are induced by the oncogenes variously know as myc, fos, fps, sarc, and sis, all carried into the original cancer cell by viruses. And, finally, the oncogene coding for a growth factor normally used by platelets (PDGF) to cause the cell division that aids in wound repair has been found to be carried by a virus into a large number of cells, leading to many different types of tumors.

From all this, it would seem that the role of other agents implicated as causes of cancer, namely chemical carcinogens and radiation, must be reexamined. It is probable that these insults to the cell merely serve to induce quiescent viruses to grow and divide, which then carry oncogenes to the next set of cells they infect, transforming them. Indeed, tumors induced by chemicals and viruses have many characteristics in common; proteins involved in transformation, such as oncomodulins and calmodulins, are identical in both. Situations in which chemicals are implicated in cancer also involve viruses; for example, the incidence of viral leukemia in marine shellfish on the east coast of the US is directly related to the quantity of organic pollutants in the water in which they live. There are, of course, many other well known examples.

Similarly, many cancers blamed exclusively on radiation exposure must be reexamined in relation to the role of viruses. For years, clusters of childhood leukemia cases around the Sellafield nuclear power plant in New England were noted and ascribed to its attendant radiation. However, recent studies have indicated that any fast-growing urban center that arose in England during the same time period also had large clusters of leukemia cases; this is the classic epidemiological indication of the influx of new viruses into a previously unexposed and isolated population, not of a dose of radiation. For example, the Scottish town of Glenrothes, which underwent a 96% increase in population during the same years Sellafield was experiencing rapid growth, also showed an increase in leukemia cases to 3 times the expected rate in the absence of any power plants and/or excess radiation exposure of any kind. This evidence clearly points to the existence of a new virus responsible for childhood leukemia, similar to the HTLV-1 retroviruses which are responsible for adult leukemia.

The definitive experiment to demonstrate the relationship of chemicals, radiation, and viruses to cancer was performed recently. As shown in Figure 4, the human tumor cell line ILO contains a radiation-induced virus, which has been termed "M" virus. This virus will turn a variety of species' cells cancerous if they are exposed to it. For the experiment, the ILO cells are irradiated, and twenty minutes later, the M virus emerges from the cells in a cloud, each

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bearing their packets of fatal information. The virus is collected (carefully!), killed, and then used to vaccinate mice; these mice will then make antibodies to the virus and become immune to it and any related viruses as well (see Figure 5 for a complete explanation). After the mice are immune, they are exposed to a potent chemical carcinogen, methylcholanthrene, a benzene-related molecule derived from coal tar. Three months later, all of the unvaccinated control

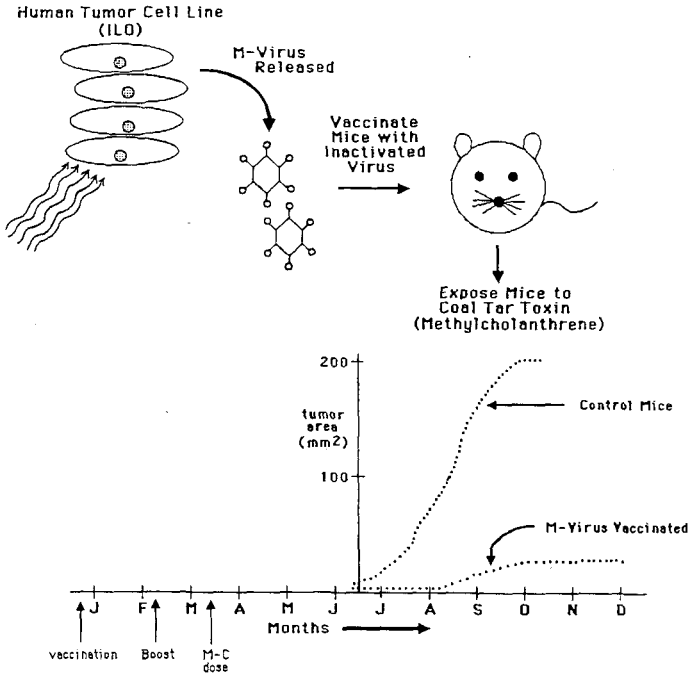

Figure Four - Experiment Showing Vaccination Against Cancer.

The link between radiation, chemicals and viruses in the formation of a cancer can be demonstrated in the experiment above. First, the human cell line ILO is radiated to stimulate the release of M-virus; subsequently, mice are vaccinated with the virus until they are immune. Mice are then exposed to the potent carcinogen methylcholanthrene, and watched for several months. Six months later, all unvaccinated mice have tumors, and are dying, while very few immune mice are ill. This experiment demonstrates that chemical carcinogens do not directly cause cancer but act through cancer-causing viruses. The role of radioactivity in stimulating the release of virus is also clear, as is the fact that these viruses are all of a closely related family; here, immunity against a human virus protects a mouse from cancer.

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mice developed tumors at the site of exposure to the carcinogen; as shown in Figure 4, these tumors were larger (as measured by their surface area) and grew faster than those of untreated mice. Ultimately, while 75% of the vaccinated mice remained completely tumor-free, 100% of control animals eventually died. The interpretation of these results is clear: the role of radiation in carcogenesis is to induce virus from infected cells. These viruses then mediate the formation of cancers. Chemicals can also trigger viruses in the same way as

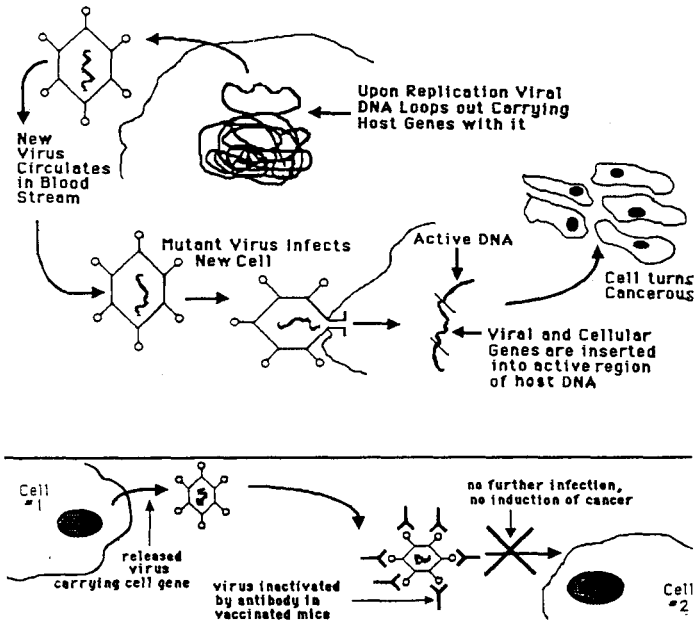
New Virus Circulates in Blood Stream
Upon Replication Viral DNA Loops out Carrying Host Genes with it
Mutant Virus Infects New Cell
Active DNA
Cell turns Cancerous
Viral and Cellular Genes are inserted into active region of host DNA
Cell #1
released virus carrying cell gene
virus inactivated by antibody in vaccinated mice
no further infection, no induction of cancer
Cell #2

Figure Five - Replication and Blocking of an M-Virus.

When viruses are triggered to leave a host cell DNA by radiation, they can take with them a cellular gene that normally was under tight control. The next cell infected by the virus will not have these controls available at the site in the DNA where the virus integrates. Then, if the cellular DNA codes for growth factor, or some other disruptive factor, the cell will become cancerous, and the gene is now termed an oncogene. The lower panel illustrates the result of vaccinating a mouse with these viruses; now when a virus carrying on oncogene is released from cells (following chemical or radiation stimulation) it is set upon by anti-virus antibodies in the blood and fails to pass on its deadly package of information. Since experiments (as in Figure 4) have clearly shown these viruses are similar, the possibility now exists of wholesale vaccination against the risk of cancer.

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radiation, by damaging DNA, and inducing the viruses contained therein to move on. Figure 5 shows this in a schematic way. Most significant in this experiment is the observation that viruses derived from human cancer cells should prove effective in guarding a mouse against a chemical carcinogen; it opens up real hope that these viruses are sufficiently related for a vaccine effective against their entire family to be made. This vaccine cocktail could then render the entire population immune to chemical, radiation and viral risks for cancer—the cure at last.

CONCLUSIONS

The end of cancer would be an incredible achievement, ending a reign of terror that has afflicted Earth's animals for at least 100 million years. We have seen that for a cured disease, like tuberculosis, there is a declining death rate for those who acquire the disease, while, if a vaccine has been found, the incidence rate declines greatly. It is clear that no advance of this significance can yet be claimed for cancer. However, the four new approaches to cancer that we have seen could, between them, render a legitimate cure for the great scourge. Watch for them, on the news, in the hospitals, as they break like a storm and transform the most optimistic science fiction into science fact. ■

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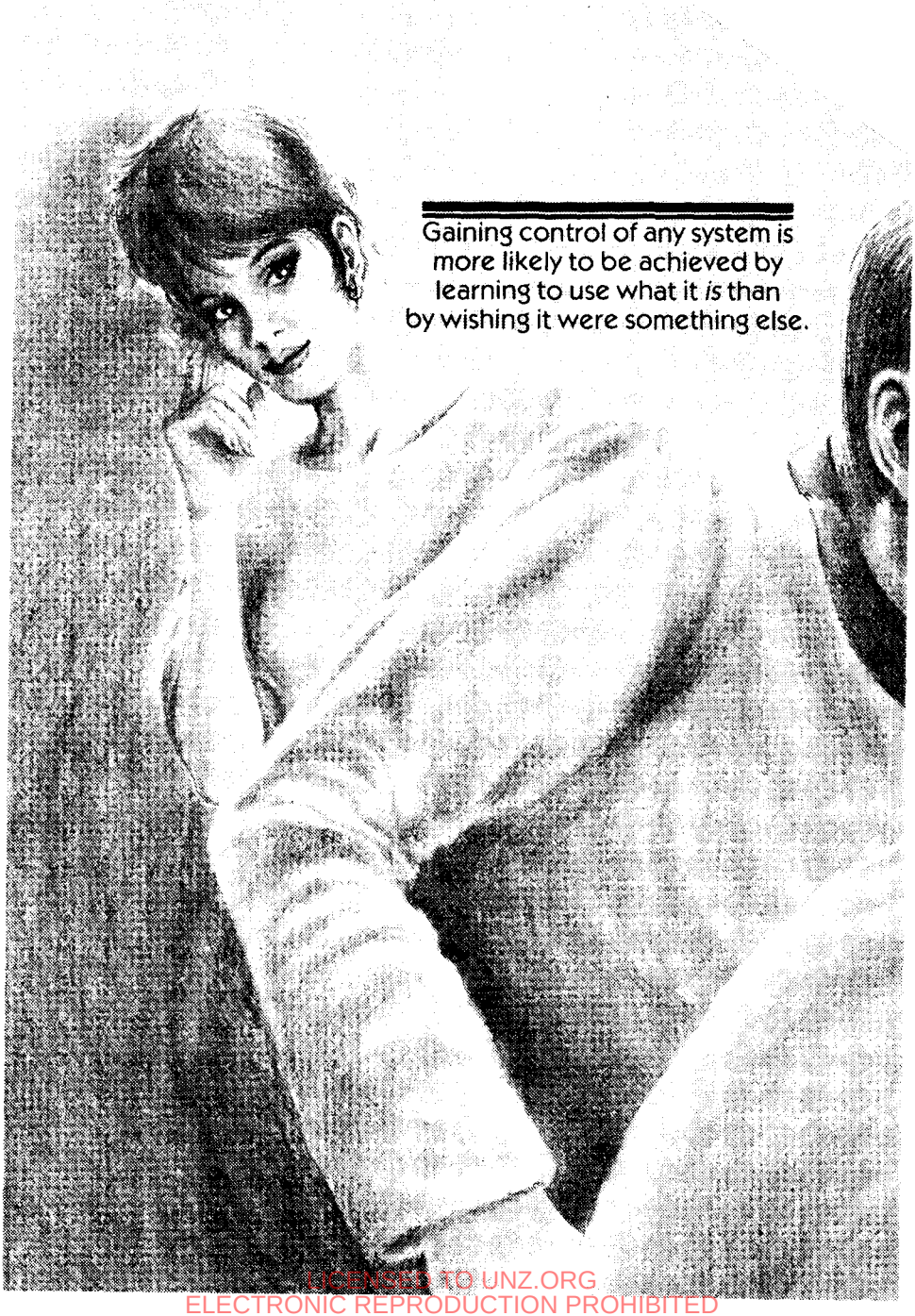
Gaining control of any system is more likely to be achieved by learning to use what it *is* than by wishing it were something else.

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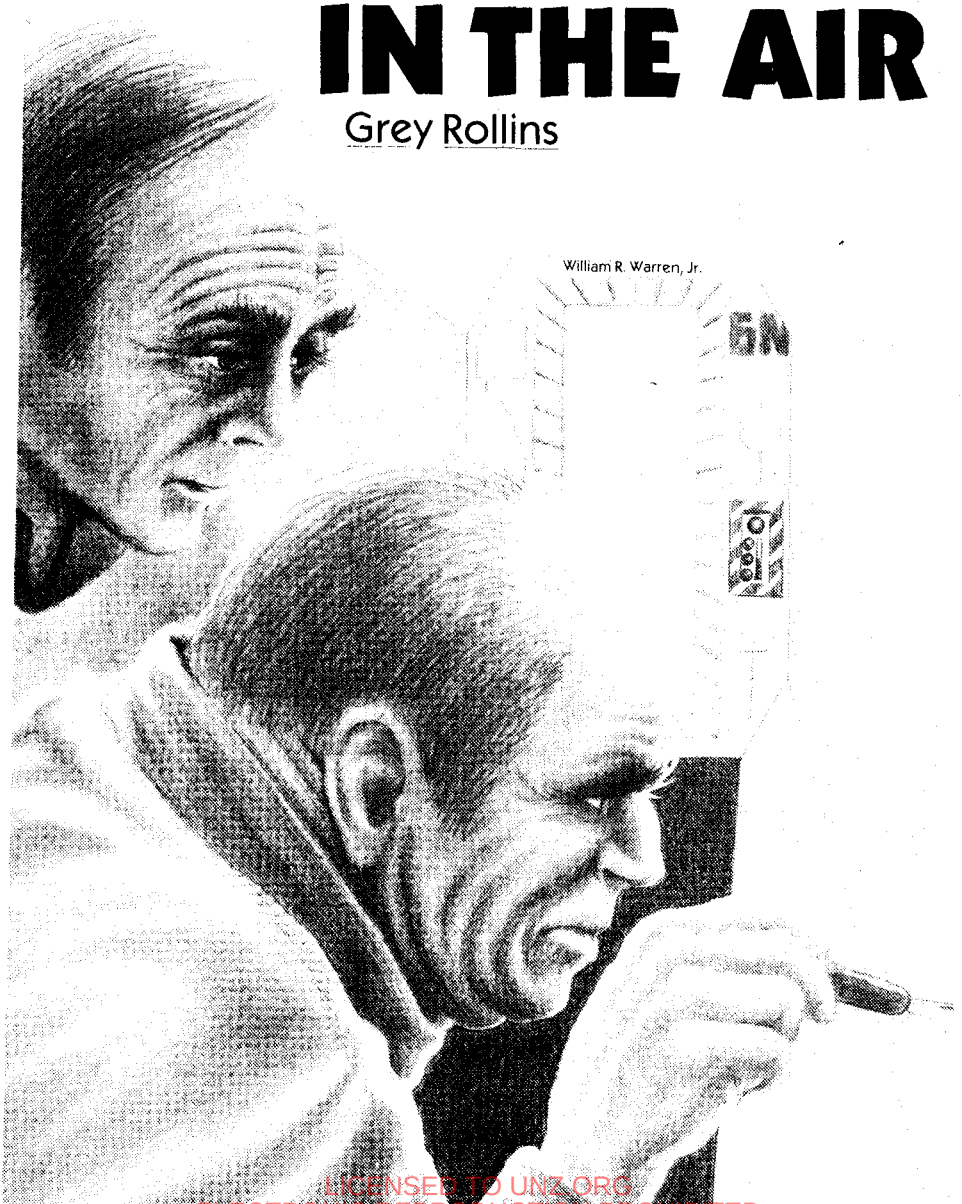
SOMETHING IN THE AIR

Grey Rollins



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The chime at the portal had an authoritative sound to it. Grumbling under his breath, Robert Beno stabbed the button to activate the speaker. "Yes?"

"Mister Beno?"

"I am the only person who lives here. Hence, if someone answers, it must be me."

"We would like to talk to you, Mister Beno."

"You're talking to me now," Beno pointed out. He was reasonably certain that he knew who it was, but he saw no reason to give away any psychological advantage, however slight.

"It's about your air fee."

"I've already paid this month's fee," he growled.

"We know. That's what we came to see you about, Mister Beno."

Robert Beno scowled. He knew that he was going to have to deal with them sooner or later, but he wanted to make it as inconvenient as possible. "I'm paid up," he repeated.

"Mister Beno, may we come in please?"

Beno allowed himself a grim smile. Passersby out in the open corridor would be making them uncomfortable as they stood talking to a closed portal. Having set the tone of the conversation, he prodded the tab which would open the portal.

The two men standing out in the corridor both wore the pale blue jumpsuits of the Lunar Air Commission, which governed the dispensing of air in Crisium. Their faces were studies in exasperation. The taller and slimmer of the two managed a strained greeting as he entered. The shorter one said nothing at all.

"Now, what is it that you want?" Beno demanded.

"We came to talk to you about your bill, Mister Beno," the taller one said.

"You already said that. I seem to recall telling you that I have paid through the end of the month," Beno replied.

Obviously restraining himself, the taller one spoke in measured tones. "Allow me to introduce myself. My name is Howard Kames. This," he said, gesturing at his companion, "is Nike Pondarillo. We have come to discuss your air fee with you."

"By my count, that's the third time that you've said that you were here to talk about my fee. I am not hard of hearing, nor am I . . . yet . . . senile. Can you be more specific, or are you going to tell me again that you have come to discuss my air fee?"

Kames's face reddened slightly. "Well, Mister Beno, actually what we were concerned about was your method of payment."

"I paid in valid currency."

"Pounds sterling? Whatever possessed you to pay in pounds sterling?" Nike Pondarillo demanded querulously.

Beno affected to look surprised. "Has England fallen on hard times? The last I heard, their currency—"

"But not on *Luna!*" Pondarillo said forcefully. "By the time we could get your payment exchanged for Lunar dollars, the exchange rate had dropped and we lost on the transaction."

"That's too bad. According to this morning's rates, if you had waited until today to make the transfer you would have realized a 3 percent profit." He looked apologetic. "I can hardly be

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blamed if your accountants have not the wit to wait until the rates are favorable to make the exchange."

"But we have no facilities for floating foreign funds while the market fluctuates!" Pondarillo exploded.

"Maybe you should look into that. It could be very lucrative for your company," Beno suggested mildly.

"You are being deliberately obstructive!" Pondarillo shouted.

"Indeed? Where on the billing statement does it state that it must be paid in Lunar dollars? I don't think I have ever seen such a notice."

Kames spoke up. "Mister Beno, we are trying to be reasonable. As you are no doubt aware, we can cut off your air for non-payment." He held up his hand to forestall Beno's comment. "We will consider your bill paid for this month, but if you continue with this unreasonable attitude we will cut off your air. We can also place a lien against your tunnel and your belongings to recoup our losses." With this he turned on his heel and stalked out the still open portal. Nike Pondarillo gave Beno one last hard glare before following.

Smiling, Robert Beno absentmindedly hit the tab to close the portal. Once more he had won out over the Lunar Air Commission. Now he would have to start planning a new way to annoy them next month, for he was sure that there would appear a small notice on next month's bill that all sums due would henceforth be paid in Lunar dollars.

Before he could put his next plan into action, however, he received a request to meet with one Clifford Weber at the Lunar Air Commission offices. He considered deliberately ignoring the invitation, but decided that it would prejudice his case in the event that he had to go to court.

At the appointed time, he walked through the enormous clear plastic doors emblazoned with the LAC logo. Bypassing the line at the payment window, he walked across the polished floor to the reception desk where a pleasant young woman with a perpetual smile barely glanced at him before touching the button on her intercom.

"Mister Beno is here, sir."

Beno raised his eyebrow. "You know me?"

"I was told to expect you at this time." She stood and gestured to his left. "This way, Mister Beno."

Once in the office, he stopped and stared in unfeigned admiration. The desk and walls were panelled in real wood, obviously imported at great cost from Earth. The office would have done credit to a VIP on Earth, but here on Luna the cost of the imported goods that had gone into its construction made it even more impressive.

A distinguished man with graying temples spoke as he rose from behind the desk. "We find that an attractive office is conducive to good business dealings."

Beno nodded. "I never suspected that you folks did yourselves so well," he said as he took the other's outstretched hand.

Weber hesitated a split second. "Well . . . yes. But, as I said, we view this as a purely necessary business expense."

"I'm sure," Beno murmured as he

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took the proffered chair, a plush executive model.

"Can I get you something to drink?" Weber offered, gesturing at a small bar fashioned from walnut and built into the wall.

Beno shook his head. "I'm afraid not. I make it a point never to drink until all business has been concluded."

Weber seated himself behind his desk and leaned forward on his elbows. "Mister Beno, we seem to have a problem. For some reason you seem to have singled us out as a target for harassment each of the last five months." He paused and looked at Beno quizzically. "Is there some reason for this?"

"Yes."

After waiting for a short time, Weber decided that no further answer was forthcoming. He asked, "Would you mind elaborating, please?"

Beno smiled pleasantly. "Considering that you have there on your desk a terminal which, unless I am sadly mistaken, can access your master database, I imagine that you are familiar with every particular of my case already."

Weber sighed and sat back in his seat. He nodded. "You are correct, sir. However, I wanted to hear it directly from you in case there was some detail that had escaped my attention."

"Frankly, I find that difficult to believe."

"Indulge me."

Beno smiled. "Very well. I think I can put my position into a very compact statement." He sat forward and counted off his points on his fingers. "One—I have installed my own oxygen regenerating devices. Two—the capability of these devices is more than sufficient for my needs. Indeed, I typically run at 10 percent over my projected needs just to be sure that I do not draw on the city capacity. Three—as I am now regenerating my own oxygen, I feel that it is unfair for the Lunar Air Commission to bill me for a service which I no longer use." He closed his hand and sat back in the chair. "There you have it. I cannot see how anyone could fail to see the logic involved."

Weber was silent for a moment before speaking. "I see. Just to satisfy my curiosity, what made you decide to install your own regeneration equipment?"

Beno smiled broadly. "Ah, there you have something that may not be in your databases. I'm not sure that I ever stated so in my communications with your offices, but . . . alas, your air does not smell good to a man accustomed to the out-of-doors back on Earth."

"But our air has less than six parts per—"

Beno held up his hand. "I know, I know. The air is certified by the LAC to be this and that and the other thing. I have no complaint with the purity of your product in a life-sustaining sense. My objection is with the odor of the air. That is a bit more difficult to substantiate, I realize, but I assure you that it is a valid complaint."

Weber frowned. "What exactly is the scent that you find so disagreeable?"

Beno fanned the air before his face. "The best way that I have found to describe it is that the city air smells canned or metallic. I realize that leaves a great deal to be desired as far as the technical aspect of the problem goes, but it is the best short answer that I have yet found."

Weber frowned. "But surely you

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must have long since grown accustomed to any residual odors in the air here. After all, try as you might, I honestly doubt that you could smell any given odor past the first twenty-four hours. I would even go so far as to acknowledge that you might be able to smell something particularly sharp, such as pure ammonia, for a longer period of time, but I assume that is not the problem here."

Beno nodded. "Insofar as your statement goes, it is correct. Let me try another tack. Have you ever noticed that each residential tunnel smells different? In this one they like to eat Mexican food, in that one they prefer Italian. These smells permeate the furniture and clothing and make each tunnel distinctly different. I find that the situation is exacerbated by the fact that it is not possible to open the window and air out one's tunnel. The smells accumulate and each tunnel has a strong odor of its own. Not always unpleasant, mind you, but certainly not fresh."

"Hmmm. I think I see where you are heading."

"Quite possibly. Since I can go to different parts of the city and clear my nose of any one given odor, I have taken to trying all the open spaces in the city. There are slight variations, but I think I can safely say that I can identify the underlying smell of the air itself —separate and distinct from the smells that are purely local to each tunnel. Another valuable test is to go out onto the surface for a while in my suit. That air smells entirely different and provides a convenient cross-check. A trip to another Lunar city, such as Besselton or New London, provides another referent."

Weber looked at Beno thoughtfully. "That leaves the question of why *all* of our customers are not complaining, if the odor is so objectionable as you seem to think."

Beno nodded. "As you might imagine, I have asked a great number of people whether they like the smell of the air in the city. I find that about three in four dislike the smell, but are simply not motivated enough to do anything about it. A few are motivated, but do not know anything about the mechanics of setting up their own regeneration units. Naturally, I did not know anything about it when I started, but I did a bit of research and found that running a small-scale system was quite easy and not too terribly expensive." He shrugged and said deprecatingly, "I realize that my little setup is nothing compared to the complexity of the machinery that you use. I did not view what I was doing as unusual in any way until I tried to get my air service discontinued."

Weber sat back in his chair and twisted a golden pen between his fingers. "We are not trying to be difficult, but as I am sure you realize, all of the utilities to your tunnel are bundled together in the service tube that runs beneath the floor of the corridor outside your portal. To send a man up that tube to find your cutoff would be quite difficult and even a little dangerous."

"Nonsense!" Beno interjected. "That is pure balderdash. I am a man of over fifty years and I have been in to see the cutoff to my tunnel several times. It is clearly marked and quite easily gotten to. Considering that any of the young pups that I see riding your service carts are probably half my age, I am sure that

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it would not be the work of a minute to drop into the service tube, crawl the ten meters or so to my cutoff, and back out again."

Weber exploded, "You've been in the service tubes!"

"Of course," Beno said imperturbably. "How else could I be sure that I was not asking for the moon, if you will pardon the expression, without checking the matter out for myself."

"But that's *illegal!*" Weber thundered.

"Hardly. The service tube was laid in as public property when the tunnel was dug by the city six years ago. It is quite legal for anyone who takes a notion to do so to crawl down in there as long as they do not tamper with the property of the utility companies."

Weber settled back into his seat angrily. "There is no way to cut off the air to your tunnel as long as it is inhabited. The computer programs are set up that way to keep from accidentally killing someone by asphyxiation."

Beno sighed. "In that case you had better have a talk with your man, Howard Kames. He seems to be under the impression that he can turn off my air any time he chooses."

"He said that?" Weber spluttered.

Beno nodded. "He threatened me with that very thing just two weeks ago in my living room. In retrospect, perhaps I should have had him do so at the time. You can hardly charge me for a service that you have turned off and it makes no difference to me whether it is turned off in anger or in cold blood as I am already regenerating my own air."

Weber was clearly losing his temper. "Mister Beno, what Howard Kames said to you two weeks ago is of little consequence. I will speak to him later about this matter. However, this I can assure you—what you are asking is impossible. We can not and will not turn off your air supply while you remain alive and reside in that tunnel. And for as long as we are supplying air to you we will bill you for that service." Weber found himself leaning over his desk with a florid face and a raised voice. Embarrassed, he sat back down in his seat with as much dignity as he could muster. "Will there be anything else, Mister Beno?"

"No, I don't think so. You have made your position quite clear. I will consider what steps to take next." He stood and turned toward the door.

Just as Beno reached for the polished brass knob, Weber said reflexively, "Have a nice day, Mister Beno."

Still shaking his head and chuckling to himself at the unconscious irony in Weber's last statement, Beno stepped onto the westbound slideway in front of the LAC offices. He had an errand to run before he went back to his tunnel. Something Weber had said had given him the perfect clue as to how to bedevil the LAC next.

On rising the next morning, Robert Beno instructed his computer to display the morning news. Rapidly paging through the bits and pieces of other people's misfortune, he cackled in triumph as he found the item of news that he wanted. After highlighting a few paragraphs, he instructed his computer to send a copy to the Lunar Air Commission offices: attention Clifford Weber.

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Within the hour, the chime for his portal rang. "Prompt," he muttered to himself.

He walked to the portal quite slowly, then waited a moment before switching on the intercom. "Yes?"

"You certainly took your time answering!" came an angry voice.

"I think it not unreasonable that death would tend to slow one down," Beno replied serenely.

"Mister Beno, will you open this door?"

"Possibly. Possibly not. It depends on what reason you give me for doing so." He paused significantly. "We spirits are somewhat fickle, you know. Besides, you haven't told me who you are yet."

"Mister Beno, this is Clifford Weber. I would like to talk to you about a matter of great importance."

"*Harrumph!* Importance to whom . . . you or me?" Beno asked.

There was a delay during which Beno imagined Weber struggling to get control of himself. "Mister Beno, I made a personal trip down here to try to talk to you. You are not cooperating with my effort."

"Mr. Weber, you said yesterday that you would only cut off the air service to my tunnel in the event of my death. Now, courtesy of the morning news, you have been informed of my death."

The first part of Weber's reply was garbled, probably due to an excess of emotion. "Oh, you'll get your wish. And a great deal more if I have my way."

Only silence followed this last outburst. Beno turned to setting up his defenses for the siege to come.

Noon passed and Beno fixed himself something to eat by hand. Fortunately, he was sitting calmly at his table when the lights went out. Sighing, he turned, fumbled on the counter behind him and switched on the small, battery-powered light that he had set out before he made his meal.

An hour later the water that he had left dripping in the kitchen sink slowly sputtered out its last drops.

He waited until it was getting noticeably stuffy in the tunnel before he carried his flashlight over to the portal and flipped the emergency release. The metal door slid reluctantly to the side and he stepped out into the glare of the well-lit corridor. He closed the portal, stepped on the westbound slidewalk and was whisked off toward the business district, still carrying his lit flashlight.

Edgar Rice was typing rapidly into his terminal in the Crisium bureau of the Lunar Observer when Robert Beno strode into his cubicle and plopped down in his visitor's seat.

Rice looked up at Beno. "Howdy, stranger. Why are you carrying that light? Expecting a power failure?"

"Past tense, Edgar. The power has already failed. I find myself needing to ask for the boon of your couch tonight. If I am there more than two nights, I'll start paying you rent," Beno said.

Rice's eyebrows flew towards his receding hairline. "Say *what?* Does this have something to do with that little prank obit that you had me insert in this morning's news?"

Beno grinned from ear to ear. "That it does." He gestured at the terminal. "What's that? Tomorrow's editorial?"

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"Well . . . yes," Rice admitted hesitantly.

"What do you say I hand you a real fire-breathing, honest-to-god, establishment-rattling topic instead of that swill that you've been writing?"

Rice's mouth twitched. "Such as?"

Beno told him.

The next morning, Beno opened one eye when he smelled coffee. The smell of bacon pulled the other eye open against its will.

Pushing back the borrowed covers, he swung his feet off the couch and stretched prodigiously, ignoring the concert of cracking joints that accompanied his efforts. Running his fingers through his hair, he took a deep breath and grunted it out as he heaved himself to his feet. He walked into the kitchen and leaned against the refrigerator, studying the distinctly feminine back that was presented to him.

"Pardon me if I'm having a lapse of memory, but I don't believe that I've had the pleasure of meeting you," he said.

The woman glanced back and threw him a sunny smile over her shoulder. "Nope. Sessu doesn't live here anymore. I'm Hannah. Go sit down at the table, I'll have you something to eat in a jiffy."

Beno turned, mumbling to himself and shuffled over to the table, slumping into a chair just as Edgar Rice came in zipping up the front of his jumpsuit.

Rice eyed Beno. "Sleep OK, old man?"

"Old man, indeed! You try sleeping on couches when you get to be my age."

"Hannah, listen to him. Taking on the Lunar Air Commission as though it were just a small thing and he complains about my couch," Rice replied.

Hannah's voice came from the kitchen. "He's just grumpy because he expected Sessu. I was a bit of a surprise, I think."

Rice cocked his head and said to Beno, "I thought I told you about Hannah."

Beno rubbed his hands over his face in an attempt to stir up some circulation. "Must have slipped your mind." He shrugged indifferently. "What's it to me if you trade up from merely beautiful to absolutely stunning?"

Hannah kissed Beno on the top of his head as she came in behind him holding a serving plate. "Edgar, I think you should keep him around. He's good for my ego."

"My dear, there's something you need to know about Robert Beno. The man is absolutely worthless 99 percent of the time. To get him to rise to his true potential during that final 1 percent, you have to get him mad. Then you would just as lief have a wild bear loose as to have to put up with him," Rice said.

"Then why do *you* put up with him?" Hannah asked reasonably.

"Because without him my life would be intolerably boring. He stirs up trouble just often enough to remind me why I got into the newspaper business down in Atlanta fifteen years ago."

Rice bolted down his breakfast and stood. "Hannah, keep Robert under control while I go see what's stirring out in the real world. That editorial should produce an effect somewhat akin to tap dancing on nitroglycerin."

Hannah gazed fondly after him.

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"There are some men who are just not meant to live alone. Edgar needs someone to fix his breakfast and send him off to work."

"Huh! Had I a woman at home the likes of you, it would tend to *keep* me from going to work," Beno grunted.

Hannah looked at him. "My, but you're a gallant one, aren't you?"

"Perhaps when I was younger. Nowadays I eat young ladies for breakfast."

Her eyebrow raised slightly. "Really? I'm sure that something could be arranged. . . . " she said with a wicked smile.

"*Bah!* It's been so long since I had a woman I probably wouldn't remember how to . . . " said Beno, blushing furiously as he worked at his eggs.

"I'm sorry," Hannah apologized, immediately contrite. "Did I shock you?"

"No," he said abruptly.

Hannah grinned and said, "Of course not, dear, you always look as though your face were on fire."

When Edgar Rice came in at the end of the day, he had a satisfied look about him. "Ah, Robert! It was good of you to step back into my life when you did. You saved me from what was likely to be a terminal case of boredom, and I thank you for it."

"I could almost take that as an insult, you know," Hannah said.

"Now, Hannah, man does not live by sex alone, my dear."

"That's not what you said last night," she shot back.

"Dear, you'll embarrass Robert, and as he is a guest, I would rather that he did not wear the peculiar expression that he has on his face right now."

Hannah turned to Robert. "Have I embarrassed you again?"

"Well . . . "

She sighed good-naturedly. "Edgar, he must be the easiest man in the universe to embarrass. I'm afraid that I got him a bit red around the edges this morning, too."

Rice raised an eyebrow. "Indeed?" He turned to Beno. "And what did she say that got to you so badly?"

"I wasn't embarrassed. I was just a little . . . surprised."

"Huh!" snorted Rice as he turned back to Hannah. "I seem to remember a time when he wasn't quite so easily bothered. But I'm sure that the very mention of stories from that era would be enough to give hm a seizure." He scratched his chest idly. "I assume that you will be here tonight also, Robert, unless you have made plans to sleep in Aldrin Park."

"I'm afraid so. I'll need to drop by my tunnel and get some fresh clothes. I didn't take time to pack my toothbrush before I left yesterday."

Rice cocked his head. "It seems to me that we had best make the raid as soon as possible. Tomorrow morning the LAC is going to be feeling quite unhappy and I would rather not find that they had confiscated everything in your tunnel on some pretext."

"Sounds good to me. Do we go before or after we eat?" Hannah asked.

"You shouldn't go, my dear. This isn't your battle," Beno said.

"Just like a man—wanting to hog all the fun!" she pouted. "Besides, someone has to keep you two out of trouble."

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"Robert, I think the path of least resistance would be to let her come," Rice observed, chuckling.

"Uh . . . Hannah, I would be honored to have you along."

"I knew you'd see the light of reason," she said smugly.

Staring at the portal with his brow furrowed, Beno said, "Seems as though the bad guys got here first. It doesn't open to my access code."

"I'll bet they invoked the derelict clause," Rice said.

"What's that?" Hannah asked.

Beno spoke over his shoulder. "When they started Crisium, they were deathly afraid that the social ills of Earth would follow us here. They put some strong laws on the books in case they were ever needed. The one Edgar is referring to was to keep unused tunnels from being taken over by squatters and used for nefarious purposes."

Hannah frowned. "Why call it derelict? Wouldn't abandoned be closer to the point?"

Beno said, "Crisium gave Earth-based lawyers headaches years before the first tunnel was blasted. The government can't exactly own a city, but they can own a vessel, so Crisium is legally a sort of vessel. It's all a terrible tangle and the first case to actually come to court will knock the whole house of cards down and force them to acknowledge Crisium as a city, instead of some kind of oversized craft belonging to the United States government."

Rice assumed an oracular pose. "An interesting thought occurs to me. This tunnel is not actually derelict, since you left it due to a utility failure and had every intention of returning. Hence, if we break in, it's not really breaking in."

Trying unsuccessfully to suppress a grin, Beno said, "That kind of perverse logic appeals to me. Let me see if I remember how to coerce one of these locks."

An eager look grew on Hannah's face. She craned her neck in order to look over Beno's shoulder as he worked. "I knew you two would get up to some kind of skullduggery before all was said and done."

"Hannah, you have a distinct talent for forgetting things that you don't want to remember. I want you to exercise that talent and forget that you ever saw this," Rice said.

"My memory is perfect, I'll have you know. I even distinctly remember forgetting the things that I didn't want to remember, except, of course, for the ones that I forgot that I forgot."

Rice rolled his eyes. "Egad, woman, sophisms give me indigestion. Let it wait until after supper, at least."

"Orwell lives," Beno muttered as he began to loosen the screws to the cover plate on the lock with the blade in his knife. After splicing two wires and using his knife blade to make a momentary short between two contacts, the portal ground open.

He straightened and said, "Hardly an elegant way to enter my own tunnel, but . . . "

Hannah gave him an appraising look as she slid past into the darkened tunnel. "Where did you learn to do that?"

"Do what, my dear?"

"Open portals that way."

His face the very picture of wounded innocence, Beno said, "Who, *me?* All

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I did was take a look inside the lock mechanism to see if there was anything I could fix. I must have joggled a loose wire or something—all of a sudden, it just opened."

She frowned. "Won't tell, huh? Party pooper!"

Rice looked up from where he was playing his flashlight over the underside of the recirculation mechanism for the algae tank. "You don't suppose that they'd rig an alarm to the door, do you?"

"Honestly, I don't think so. I doubt that they expected that I would know how to jimmy the door. On the other hand, our rationale for being in here is not quite as solid as I would like."

Hannah walked over to stand next to Rice. "I suppose this smell is due to the algae being dead."

Beno nodded ruefully, his face barely visible in the backwash from his flashlight. "Unfortunately, yes. When they cut off the power, the recirculating pumps quit. Some types of algae can live in stagnant water, but not this one."

"You told me yesterday that it was derived from a green algae of some sort, didn't you?" Rice asked.

"Yes, they started with *Ulothrix*, a common green algae, and did a little genetic manipulation. That was marketed under the trade name Light June. That's what they use up in Besselton, for instance. Since then they've improved it a bit. The next version was Light May, which is what this is . . . well, was, I guess. Now they're coming out with a still newer strand called Dark May."

"What's with the months?" Hannah asked.

Beno shrugged. "Just marketing, really. They're working backwards through the year to try to indicate how fresh they smell. The implication being that spring air is fresher than summer air, which you usually think of as being heavier. The light part means that the free oxygen yield is comparatively less than a dark, which refers to the color. The chlorophyll concentration is higher in a dark, so you can get the same oxygen output with less algae."

"OK, I guess that makes a kind of cockeyed sense. What are the little stairs for?" she asked.

"The system works better if the algae has plenty of light, so the little plastic stairs provide extra surface area for the algae to spread out. After all, it's just a plant that lives in water—it needs light to carry on photosynthesis. There's a small pump underneath the rig that pumps water up to the top of the steps. From there it dribbles down over the algae to the reservoir at the bottom."

"Neat, I want one for our tunnel!" Hannah exclaimed.

Rice and Beno exchanged glances. "As of tomorrow, we're hoping that a lot of people start saying that, but right now we need to get out of here."

After quickly packing some clothes and taking whatever perishables had not already spoiled, they slipped back out the portal. Beno nodded politely to a neighbor that they happened to meet in the corridor, then turned to Rice.

"You know, it occurs to me that it wasn't terribly discreet of you to be seen with me. It's not like I'm a criminal, but I'd rather not drag the two of you into this if it can be helped."

Rice waved him off. "Think nothing

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of it. The pen is mightier than the sword and all that. If they start on me I am fully prepared to fire an editorial broadside that will singe their hides." He paused for a moment. "As a matter of fact, I may just let it slip out that you're staying in my tunnel. I would almost welcome some nasty trick like they pulled on you."

Hannah glanced at both of them. "If I didn't know better, I'd say that you two are secretly enjoying this."

Beno shrugged. "If they had cut my air off like I asked, this would not be happening."

"Huh! This is just an excuse to go camping and you're enjoying every minute of it."

Rice sighed. "Robert, I forgot to tell you that Hannah has an alarming knack for understanding the deeper motives of men."

"It's not so much that I mind having my mind read," Beno replied, "it's that there's only one of her and you've got the market sewn up."

"Just lucky, I guess."

Not having slept well his second night on the couch, Beno was sitting at the kitchen table when Hannah scuffed in rubbing her eyes.

"Up early, I see," she said. "Couldn't sleep?"

Beno shook his head. "Nope. If I yawn at you, please don't feel insulted. It doesn't mean I'm bored."

"Would breakfast help get your motor started?"

"Probably. I'm more interested in what effect our little bomb is having."

Hannah raised an eyebrow. "Bomb?"

"Edgar and I set up a little present for the LAC. Yesterday's editorial was just to soften them up—the first real hit comes this morning."

"Let me guess. You're going to import air from Earth—"

"Not quite, Hannah, but you're warm," Rice said as he came in and sat at the table. "We're going to publish an article on how to build your own algae tanks. Even if no one wants to build a tank, it should stimulate some interest in Robert's plight. On the other hand, if any significant number of people show interest, it should make the LAC very nervous indeed."

"Well, I should think so," Hannah said. "They have a monopoly here. Anyone who threatens that is going to be on their blacklist instantly, if not sooner." She paused. "Surely they won't just sit back and let you get away with this."

Rice laughed. "Never underestimate Robert Beno, my dear. The man has laid out a plan that will give the LAC an out and profit him as well. They won't like it, mind you, but he hasn't left them much choice."

"What's the plan?" she asked.

Rice stood. "It's Robert's idea. If you can get him to tell you, then more power to you. I'm going to head in to work early so I can catch the first reactions to the article and plot out the next step."

"Drat that man," she said as she watched him leave. Turning to Beno, she asked, "Well? What's the big secret?"

"Modesty is my most prevalent trait, Hannah. I cannot bring myself to brag about something that may not work."

"You still haven't had breakfast,"

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she pointed out. "I could burn your pancakes, you know."

"Now, Hannah, you should know better than to threaten a bachelor with having to fix his own food. I've been doing my own cooking for ages."

"Robert, *you* should know better than to pique a woman's curiosity."

"I wasn't the one who said anything, Edgar was."

"You're a slippery one, I'll grant you that."

"Let's just hope that the LAC thinks so."

Rice called at ten. "Look's as though we're onto something, folks."

"How are we doing?"

"The replies coming in through the computer net peaked just after nine and have nearly tapered off now. We'll get another, smaller surge at lunch, but I don't think it will change the percentages. So far we have had eighteen hundred replies. Of those, 27 percent wanted more information on building their own recirculation systems. An additional 54 percent weren't interested in building their own, but thought that the LAC was bullying Robert unfairly. I'll bet the LAC is starting to sweat blood right about now."

"Fine by me," Beno replied. "It won't hurt my feelings if they suffer a bit."

At two, Rice called again. "Two things. The first is that the lunch crowd didn't change the stats any." He paused significantly. "Now for the second item. You're going to love this."

"Something good, I take it."

"You betcha. Someone wants to talk to you."

"I'm almost afraid to ask."

"Try Clifford Weber of the LAC. He's guessed that I know where you're hiding out and called a little while ago wanting to know if I could get a message to you."

Beno laughed. "I'm inclined to let him stew a bit, but you're in a better position to judge the situation. What was his message?"

"He didn't say. I didn't talk to him—one of the folks up front did. They had the wit to be noncommittal about it and put him off."

Beno nodded. "Let's let him roast a while longer. If you're getting the kind of response that you say, I would imagine that they're getting a little bit over at the LAC. That should be giving Weber something to think about."

"Want to put a time limit on it?"

"Yeah, Let him slide until tomorrow morning. A sleepless night for Clifford Weber would just about make up for my sleepless night on your couch."

"You've got it. We'll stonewall him."

Just after five o'clock Rice came in, grinning widely. "Want to know the latest?"

"What?"

"We were given a small item for insertion into tonight's news. It came from Captain Cromwell of the Crisium Police Department. He seemed very insistent that a notice be put in tonight's news that there had been a burglary at the tunnel of Mister Robert Beno. The thief or thieves had forced entry by means unknown and had made off with some of Mister Beno's personal belongings.

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Value of the missing belongings was unknown due to the absence of Mister Beno . . . blah, blah, blah.''

Hannah was chuckling to herself. ''I love it. I've been a lot of things during the course of my life, but I believe that this is the first time that I've been an outlaw.''

''Did you run it?'' Beno asked.

''I debated the point, but decided that I would. If nothing else, we can say that if the power had not been cut off, your tunnel would have remained secure. We can let that theory go on long enough to make an impression before we 'discover' that you were the thief.''

Beno nodded. ''I like it.''

''Have you been able to substantiate a link between Clifford Weber and Robert's power being cut off?'' Hannah asked.

''Not directly. I called Crisium Electric this afternoon and pointed out that they had not had a communique from Robert requesting that his power be cut off. Their response was that they were acting on the obituary in Tuesday's news to protect their wiring in case of fire. I assured them that it was a mistake, and, as Twain was quoted to say, that the reports of Robert's death had been greatly exaggerated.''

''What about the water?''

''They didn't have any comment. They just said that they were happy to hear that it was all a mistake and that they would turn on the water immediately.''

''In other words, Robert could move back into his tunnel tonight if his algae hadn't died when they cut off the power.''

''Essentially, yes.''

Beno shook his head. ''The ironic thing is that I had just ordered a pair of batteries to keep the system functioning in case of a power failure. They should be here in another week or so.''

''That's nasty. It means that you'll have to live off of the LAC's air until you can get your algae tanks redone.''

Beno shrugged. ''It can't be helped. I never envisioned it being this big an ordeal. All I wanted was better smelling air for my tunnel. Now it's turning into a circus and if I don't learn how to ride an elephant quickly I'm going to get trampled.''

Beno followed Rice to work the next morning. His picture having ran in the morning and evening news the last two days, he was recognized as they rode the slideway across town. By the time they reached the Lunar Observer, a small knot of people had accumulated around Beno.

Rice stopped them at the portal, telling them to put all questions and comments on the computer based discussion group and that Beno would get to them as soon as possible.

''Now we can deal with them at a more leisurely pace . . . or ignore them if that seems the thing to do.'' Rice said.

Beno said, ''Oh, I don't mind answering questions. If nothing else, it will be a good start on phase two.''

As soon as they made it to Rice's cubicle, the com screen lit. ''Mr. Rice, I have Clifford Weber on the line. He wants to speak to you or Mr. Beno. Do you want to take the call?''

Rice glanced at Beno. ''Well? I don't have anything to say to him, but you can talk to him if you want.''

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Beno considered for a moment. "Sure. Might as well get this over with."

Rice shrugged. "On your head be it. Do you mind if I record this?"

"No, go ahead. I don't have anything to hide and he might say something interesting."

Rice nodded to the image on the screen. "OK, Melanie, patch Weber through." He backed out of range of the video pickup.

Clifford Weber's distinguished face appeared on the screen. A surprised expression formed. "Ah, Mr. Beno, I didn't honestly expect to be able to speak to you face to face. I trust that you are doing well."

Beno allowed himself a tight smile. "Quite well for someone whose tunnel ceased to function."

"Ah, yes, understand that you are having a bit of difficulty there. I was calling to see if there was any way that we could make peace. I was only trying to look out for your safety and best interests. Witness the state of your tunnel. If there had been a real power failure, you would have suffocated by now. We actually did you a favor by pointing out this weakness in your plan before it came to a tragic test."

Ignoring the triumphant expression on Rice's face, Beno said, "I was aware of the possibility. I had already ordered the equipment necessary to provide for electricity in the event of a power outage. In that circumstance, I would actually be able to hang on longer than if I were dependent on your air system. Incidentally, isn't your air system run off the same power as my tunnel?"

"Well, yes, but we have substations on each level that have their own backup power for emergency use. You would be provided for in the event of a power failure."

"But is it not true that if my tunnel were independently provided for, then your substation would have somewhat less demand, hence you would be better able to service your other customers on my level?"

"Well . . . "

"So you see, Mr. Weber, I am actually making things easier for you."

Weber was beginning to lose his composure. "That's very kind of you, but we would be better able to control the situation from a central point."

"With one less tunnel to control, that would enable your personnel to be that much more alert to problems elsewhere."

"We are perfectly able to handle our end of things without your assistance, Mr. Beno. If you insist on publishing diagrams of air recirculation plants in the news, it will only create anarchy."

Beno contrived to look apologetic. "I do not control the news broadcasts, Mr. Weber. There are times when I wish I did. It was an uncomfortable sensation this morning for me to be recognized by so many strangers on the slideway." He shrugged. "But, as I am sure you realize, this is a newsworthy situation, no matter how small it is in the overall scheme of things. The reporters would be remiss if they did not include at least some coverage of a man being forced out of his tunnel by the utility companies. After all, it could happen to them."

"It wouldn't have happened to *you* if you had taken a more reasonable attitude, Mr. Beno!" Weber snarled.

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Careful to keep his tone even, Beno said, "I was under the impression that I was being reasonable. All I asked from the very beginning was that you turn off my air and quit charging me for a service that I no longer needed. I might add that it appears that the greater portion of the population of Crisium seems to agree with me, if the survey results that Edgar Rice published in today's news are correct."

Weber looked distinctly uncomfortable. "We are aware of the survey results. In our opinion, the way the questions were phrased reflected a bias towards your own position. That would make the survey invalid."

Beno shrugged. "As I said, I have no power over the news. I did not formulate the survey, and cannot be held responsible for its content. I'm sure that the staff here did the best that they could in a short period of time. However, in passing, you might note that it closely approximates the rough guess I gave you that three in four people were dissatisfied with the air quality here."

"Mr. Beno, I am not here to discuss the correct methodology for setting up a survey. I called to see if there was some way that we could reach an understanding. This has gone on long enough and I—"

"I agree that it has gone on long enough, Mr. Weber. After all, I began trying to get the LAC to turn off my air over five months ago. Now, what is it that you suggest?"

Weber opened his mouth to speak, then thought better of it and closed it again. His second try came to fruition. "At this point, I believe that it would be more than generous of the LAC to waive the reconnect fee for your air—"

Beno's eyes opened wide. "Excuse me? Who said that I wanted my air reconnected?"

"But—"

"I fully intend to get my air recirculation system underway again as soon as possible. I will have no more need of your air than I did before this whole ridiculous mess started. I feel that I should warn you that if I get any more static out of you, I will consider bringing a suit against the LAC for damages resulting from the destruction of my algae, being forced out of my tunnel, and mental stress."

With obvious effort, Weber brought himself under control. "Mr. Beno, you are making no effort to meet me half way on this problem. I have extended an offer to waive the usual reconnect fee, yet you seem stubbornly opposed to reconciling our differences."

Beno smiled gently. "I suppose that it will be necessary for me to fall back on my reserve plan."

"And what might that be?"

"You will find out soon enough."

Robert Beno followed Rice into work again the next morning. This time they took a circuitous route that allowed them to escape the notice of their fellow citizens.

The morning news had been sent out over the computer network to subscribers thirty minutes before. They did not have long to wait before the expected call materialized.

"Mr. Rice, Clifford Weber is on the line again," the secretary said, the beginnings of a smile on her face.

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Rice smiled back at her. "Go ahead, Melanie."

Weber's face materialized. "Beno, what are you *doing?* The phones are ringing constantly over here asking about our new line of private algae tanks!"

"Oh, I'm terribly sorry, Clifford. I thought that you were in business to make a profit," Beno said.

"*What?*"

"You *are* in business to make a profit, aren't you?"

"Well, yes, of course," Weber spluttered.

"Then perhaps you would rather pay for your advertising yourself?"

"Beno, what are you talking about? Are you insane?"

"No, I just thought that I might save you a few dollars by placing your first ad for you."

"Beno, you had better start talking sense. We've already received well over a hundred calls this morning for a product we don't even carry."

Beno said, "If you have received that many calls, then I take it that there is an unfilled demand in the marketplace. Do you not see it that way?"

"But—"

"Mr. Weber, this is the deal. There is obviously a market here for privately owned recirculation gear. I thought about opening an outlet myself, but frankly I don't want the headaches. Since you already have the air market cornered, my next thought was that you might want to keep your monoploy. All you have to do is take the product line and tell these people that you will set them up as soon as you can get the starter kits up from Earth. If you don't want the business, then I may well decide that the profit would outweigh the inconvenience and go into business against you. We would then simply publish a notice in tomorrow's news that the number in today's news was incorrect . . . a typo, and give my number instead."

"You can't possibly be serious!"

"Oh, but I am. You see, the support market for these units should be quite lucrative. There are trace elements to be added to the water and other odds and ends. The profit margin is quite high."

Weber became quite still for a minute. "How high?"

Beno shrugged. "Oh, on the order of 200 percent," he said casually. "But, of course, if you'd rather not take the line—"

"I didn't say that!"

Beno permitted himself a small smile. "Every call you turn away is losing you money. By your own admission, you have already lost over a hundred potential customers."

"*Damn* you, Beno!" Weber cursed. "All right, all right. What do we need to do?"

"The first thing you should do is to start taking the names and numbers of all those customers that you're turning away. Tell them that you'll have concrete information on pricing and availability by the end of the week."

"I trust that this is not a trick, Mr. Beno."

Beno shook his head. "No tricks. Either I go into competition against you and take half of your business within a year, or you can widen your vision of what it means to supply the air here in

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Crisium and keep control of the market. The choice is yours."

Weber was obviously at war with himself. The opportunity to keep the LAC monopoly intact was winning, however. "I'll take the chance, Beno, but I want you over here to discuss details immediately."

Beno inspected a fingernail. "I don't work for you, Clifford. You can't order me around. However, I believe that I can fit you into my schedule later today. Would lunch suit you?"

Weber forced a weak smile. "Lunch it is, Mr. Beno."

"I look forward to a long and profitable relationship, Mr. Weber," Beno said as he hit the disconnect switch.

Rice stared at his friend for a minute. "Robert, you are without doubt the most devious man I have ever known."

"Nothing devious about it, Edgar. Just a form of financial jujitsu. I let his greed trip him. He did all the work. All I had to do was make one call to Earth and establish myself as the sole Crisium distributor for the algae recirculation systems. It took a little front money to convince them that I was serious. They were all too willing to expand into Crisium. All they needed was a local representative."

Rice's eyes sprang open. "You're the sales rep? That means that you'll make a percentage off of everything that Weber sells!"

"Indeed. It won't take a lot of work for me to maintain the one account, so it should be a reasonably pleasant way to turn the tables on Weber." He leaned back in his chair and contemplated the ceiling for a moment before looking over at Rice. "I feel like expanding my market. Do you happen to know anyone in New London who might want their own recirculation system?" ■

●Even if you're on the right track you'll get run over if you just sit there.

Will Rogers

●There are two ways to slide easily through life; to believe everything or to doubt everything. Both ways save us from thinking.

Alfred Korzybski

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Jay Kay Klein's biolog

When running a mainframe computer on the graveyard shift in a sort of "atomic power plant control room," with nothing to do in the long stretches between summons to activity by blinking lights and insistent beeps, Grey Rollins found he could keep awake best by trying to write science fiction—his supply of literature having been depleted. Tens of thousands of words later, he found this practice had perfected his ability to write salable fiction. He's currently on the second shift at the University of South Carolina, and though he's still changing tapes and restoring lost tie-lines to branch campuses for the cyber-mind, Grey now writes at home on his own PC. A child of the computer age, he avers that if it weren't for cyber power with its auto-corrective features, he'd be unable to get a readable manuscript to an editor.

As to how, exactly, he puts his thoughts together to form a story, he has no idea. Somehow, the words come out of his fingertips and when there are enough words, there is the story. This illustrates a long-held theory that when you stuff assorted information into a large-capacity, relational-database storage medium, and then kick the box, interesting results get printed out in hard copy form.

Born in the Asheville area, Grey subsequently attended the University of North Carolina for a BA in geology, intending to specialize in uranium prospecting. Graduation and obsolescence came simultaneously with the demise of the American fission power program. Having been interested in psychology, he realized with just a few more courses he could also secure a BA in that field. He had thought to rearrange his credits with a few further courses and wind up with a major, or at least a minor, in physics, but was thwarted by the university's rule-book, written to the highest standards of red tape and bureaucracy.

Needing a job and always interested in electronics, he worked for a while at a high-end audio store in Columbia, SC, then joined the USC's computer services department in 1984. His first submitted short story was bounced early in 1988. Editor Stan Schmidt, though, liked the sixth one with some "tightening up," which eventually appeared in the September, 1989 issue. This was a scientific puzzle story in the tradition of such classic *Analog* stories as "A Can of Paint." Like most of *Analog*'s writers and probably its readers, too, Grey has a consuming interest in everything scientific and technological. Scholastic English was another matter, taught as it is almost universally by scientific illiterates. They most value scenes and situations that would have seemed contemporary to cave dwellers.

Currently, following the precedent set in this magazine by Robert Heinlein, Grey is working out a "future history" for the series of stories he has in mind. One projected book is to be a thriller set in a science fictional world with politics, assassination, and intrigue. He likes happy endings, but as beginning writers find out to their surprise characters have a way of running away with the plot. One thing he'd like to do is reach beyond SF readers, who are already attuned to the modern world, and get hold of the minds of the "general" populace to spoon-feed them some insights into the workings of such technological wonders as the light bulb. ■

Grey Rollins

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In the corner of the Oval Office the omnibot waited.

The weary voice of the President of the United States registered clearly on its auditory sensors. But the omnibot, unsummoned, remained silent, apparently oblivious to the intense discussion taking place across the antique wooden desk.

His handsome face showing more lines than appeared on television, the President gestured toward the now darkened VCR. The flaming torches, the bitter faces of the jobless, and the scathing sarcasm of the news commentators still hung in the air.

"Four years of work," he sighed, "destroyed by four weeks of riots!

"Sometimes I wish I'd never heard of omnis."

His visitor almost gasped, "But sir, your whole program is based on omnis, the productivity they'll bring. You can't mean that!"

"No, of course I don't. But, Barbara, if we can't get these anti-omni riots under control, we can forget my reelection, and we can forget omnibots. We'll see a general retreat from technology. And this country can forget prosperity for the next hundred years!

"Which is why the Cabinet decided to send you to Chicago. We've run out of ideas, and you're our last hope."

Shifting tone, the President grinned at his new Assistant Secretary of Labor for Technology. "Look, you've been off the University faculty for only two months. You are an authority in your field but not strongly identified with my policies. It is possible that those, uh, other parties in interest, may even be polite to you."

Turning to the omnibot, the President called out softly, "Susan, Ms. Allison will be flying to Chicago tomorrow morning. Please book her a reservation on a breakfast flight."

"Yes, sir," the omnibot responded. Its voice box used the higher of the two standard pitches, vaguely feminine.

The almost inaudible hum of its motor intensified noticeably, its top segment swiveled to realign its optical sensors, and it began moving smoothly toward the door to the secretarial anteroom.

The lamplight glinted off its polished chrome-like surface. Its three barrel-shaped segments, one on top of another in diminishing size, reminded Barbara of some metallic six-foot snowman gliding over carpet. The two short treads under its two-foot-wide base made remarkably little sound. Its three flexible segmented arms, each appearing to consist of linked metal bracelets of gradually diminishing size, sprouted equidistant around the circumference of the middle segment and waved gracefully as the omnibot moved.

A white band circled the middle segment. Between two of the arms was etched the notation: "U.S.O.& M.V.C. / Omnibot / F-5 / 21,309." Barbara automatically translated to herself, "U.S. Omnibots & Mechanical Vehicles Corporation / Omni-purpose Robot / Model 6th—Brain category 5 / 21,309th produced."

Five digits, designed to fit human products, reached forward to grasp the doorknob. In an instant the omnibot was through and the door re-closed.

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Barbara looked at the President, eyebrows slightly raised. "Susan?"

The President shrugged, shyly. "I know it may sound strange to give a name to an omnibot, but I just could not get used to calling it by a number.

"When Susan Clarke retired as my secretary, it seemed a good political move for your President to show his pride in America's newest technology by acquiring an omnibot for his personal secretary.

"And, reluctant as I am to admit it, my new secretary is even better in many respects than Susan was. The omnibot never forgets.

"Anyway, I named the omnibot 'Susan Omni Clarke' in honor of its predecessor's twenty-three years of faithful service. Besides I think the maintenance people take better care of a 'Susan' than they would of a mere mobile computer."

The President paused. "But the omni gimmick has begun to backfire."

Barbara nodded. "Yes, the unions are crucifying you for keeping a human out of work." She mentally blushed, recalling that she had actually thought some of those placards quite clever: "Another ex-secretary on the bread lines." "When's your secretary's birthday, Mr. President?"

"Which gets us back to our problem," said the President. "Omnibots are the reason they are rioting out in Chicago, and trying to burn down the new omnibot factory." He stood up. "So, Barbara, you had better get going and put out that fire!"

In the outer office, Michael Fitzgerald paced anxiously.

As Barbara Allison emerged from the Oval Office, he swiveled toward her, peering anxiously with brooding eyes.

Barbara's whole face lit up when she saw him. "Uncle Mike! What are you doing here? And at this hour? Oh, but it's so nice to see you."

She reached up and gave the big man a hug.

A smile lit his face as he enveloped her in his arms and ran his fingers briefly through her soft auburn curls. "Well, my child," he said. "Why should I not be here? Am I not the President's campaign manager?"

He chuckled, then paused. "No, it is serious business that brings me here. And that serious business is you."

"Me?" she exclaimed.

"Of course, Barbs." He added gently, "Surely you did not think the President would let you go off to Chicago without a political briefing, did you now? And who would have been doing more worrying about that situation than your little old uncle?"

"Oh, Uncle Mike," she said. "You know about that? Of course you would. All right. Let's go where we can talk."

Moments later they clinked coffee cups in the nearby conference room. Though 20 pounds heavier than when he and the President had been college friends, with his clear eyes, still thick reddish brown hair and a gentle almost baby face, Mike Fitzgerald still cut a dashing figure. His ready laughter often masked a sharp brain and keen insight.

It also masked a deep sadness. A devoted husband, disappointedly childless, he had been devastated by the car accident that fourteen years earlier had

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killed his wife, who literally had been the girl next door, and Barbara's parents. His whole life thereafter centered around being godfather to Barbara, and managing the political career of his old friend, now the President.

He and the President shared a passion for innovation. Under their leadership the party and then the Congress had joined in a partnership that over the coming four years promised sharp upward movement on all economic graphs.

But this building of momentum, the gathering of the national legs for a historic leap, lay hidden among hundreds of tiny statutory and regulatory changes, superb personnel appointments and tough-minded administrative decisions. Barbara knew the public could not easily see that. On their TV screens it seemed only that big corporations were getting bigger, that more corporations were getting huge government contracts, and that in the name of efficiency more and more people were losing their jobs.

Fitzgerald said, "Look Barbs, we both know that people have always had some instinctive, gut-level fear of robots. Soulless machines, they call them. They especially feared that robots would replace them at their jobs. But until now those jobs have always been the most simple, repetitive jobs, and those industrial robots did not even look vaguely like people.

"The new generations of robots —omnibots—are different. These omnis, clunky as they are, can be personified. Above all, they can do complicated, creative work and can replace the middle class in white collar jobs."

Barbara had made her academic reputation with her studies of the impact of technology on labor. How often, she thought, had she reminded her classes that every significant technological change had provoked violent protests against the displacement of jobholders. But she also had wondered, were the omnibots just another improvement, or were they something entirely new, a whole different ball game, a higher order of magnitude, a quantum jump, a . . .

Fitzgerald's voice interrupted her reverie. "There are three things you have to know. First, our secret polls show that we are in deep, deep trouble over the omnibots, far worse than we have admitted. Second, Wenden's going to base the rest of his campaign on the omni issue."

Barbara shuddered. The opposition candidate was not just against technological investment, but personally was both demagogic and corrupt. The thought of Wenden in the White House—

"Third," Fitzgerald continued, "certain union leaders are seizing this crisis as an opportunity to reassert their former political power. They have vowed to stop the plant from opening, and their unions will honor picket lines. If the government can't end this crisis soon, other unions will follow, and you may see the country's first nationwide general strike.

"Even if the President did give in and scaled back the omnibot projects, he would lose so much face that he could not be viewed as a credible leader, and we would lose the election anyway.

"So you see, Barbara," Fitzgerald concluded, as he finished his second cup of coffee, "whether he pushes omnis or backs off—either way—he loses. The

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Cabinet could see no way out. I proposed sending you out to look the situation over. Maybe with your background you will see something we all missed."

He paused, looking sadly at his niece. "I sort of feel like I'm throwing you to the wolves," he said. "Your reputation is now on the line, too, and I don't see any way you can come out ahead on this assignment. But the fact that I suggested it shows how important this is, and how desperate we are."

He reached forward and took both her hands in his. "Good luck, Barbara," he said.

Barbara started to rise, but Mike Fitzgerald seemed strangely reluctant to release her hands. "Barbs, honey," he said softly, "there is perhaps one more thing I ought to tell you. Or maybe I shouldn't.

"You know I am not a wealthy man. I have lived moderately, and put away some of the salary the party gives me each year. That is all that I'll have to tide me away in my old age.

"I believe in what the President is doing. I have backed my beliefs with my pocketbook. Everything I own has been invested in U.S. Omnibots stock and bonds.

"I'm sorry, but I thought you ought to know that."

He rose and left the room, never looking back. Barbara stared after him a long time before gathering her briefcase and following him out.

Barbara was still lost in thought when she turned the key in the lock of her town house. As she blinked at the hallway light, her daughter Blair bounced down the stairs and threw her arms around her.

"Oh, Mom," the 15-year-old said, "I'm so proud of you! You were all over the late news tonight. How you're going to Chicago to solve the omni mess. When no one else could. Dad would have been so proud, too."

Blair paused, thinking of her father who had died of cancer when she was in fifth grade, but the excitement returned quickly. "When are you leaving? How long will you be gone? What can I do to help? I took your suitcases out already. Mrs. Ahearn and Mrs. Higgins both called to say I can stay with them if you want. But I can stay by myself, can't I? Oh, this is so exciting."

Barbara couldn't help herself, and started laughing at her child's exuberance and faith in her mother. Blair made it sound so easy.

Barbara only wished that it was. She had no ideas.

When she reached Chicago, she still had none.

She decided to take the bus downtown, and seated herself just across the aisle from the driver's compartment.

Behind the strong plastiglass screen on which traces of dried egg and paint could still be seen, safe from most vandalism, the omnibot bus driver stood silent, but forever vigilant. Two arms controlled the wheel, and the third controlled the waist-high accelerator and brake handles. A navy blue stripe circled the top of its middle segment where a Regional Transportation Authority plaque was bolted onto it.

Barbara knew that Chicago, as the center of the omnibot industry, had

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more omnis in use than any other city. The RTA had found it financially impossible to refuse the free omnibot bus drivers donated by a U.S. Omnibots company anxious to demonstrate its product. But Barbara had never actually seen an omni driver.

As passengers came up the ramp, the omnibot's top segment swivelled to watch them deposit their fares. On one occasion its mechanical voice—in the lower pitched "male" mode—softly told a passenger, "Sir, your deposit was one dollar short. Will you please deposit one dollar more."

All the way from O'Hare Airport into the city Barbara watched the omnibot work. Never even a wiggle out of the bus lane. Never a wasted motion. And a paragon of unruffled politeness.

Barbara could not help but compare it with the human bus drivers in Washington, and wonder which better served the public.

But she also could not help wondering what had happened to the human driver who had sat where the omni now stood.

Barbara was not the only one to stare at the omni.

Behind the driver's cage three rows of seats had been removed. On the side wall above the now open area a sign warned, "OMNIBOT STANDING AREA ONLY." The area was empty. In these tense days, it seemed, no omni traveled alone.

In the first row behind this area two old men sat down, some sort of construction workers apparently; under their jean jackets frayed overalls overlapped worn boots. With heads unmoving, they stared fixedly at the omnibot's back. They never said a word, but as they passed the omnibot's cage when leaving the bus a few stops later, one turned and spat violently against the plastiglass. The other futilely banged his fist on the cage, muttering, "Bastard job stealer! Baby killer!"

But not all the passengers reacted like that. Perhaps a quarter of them looked uneasy or, occasionally, hateful, as they walked past the driver's cage.

Most just seemed unaware of the driver.

"Three to one," Barbara thought. "There's hope."

But then, almost downtown, the bus passed within view of the U.S. Omnibots plant. Even from the highway Barbara could see and hear the chanting mobs that were barricading the plant. Like a castle under siege, she mused, and wondered briefly whether the omni driver had any awareness of the threat to the nursery from which U.S. Omnibots intended to bring forth its mechanical siblings.

As she was about to enter the federal building housing the Labor Department's regional office, she felt a tug at her arm.

Startled, she glanced around to see a haggard young man dressed in faded jeans under a shabby jacket, collar turned up against the autumn chill. Peering closely at her face, he said, "You're Barbara Allison, aren't you? The Labor Department person from Washington? I saw you on the news. I hoped you'd be coming here.

"Listen," he said, looking around nervously, "you can't let them stop the omnis! You just can't!"

Barbara stared at him with surprise.

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"Look," he said, "I'm a graduate student. But I almost wasn't. If I gave up my job I couldn't afford the tuition. So I was stuck at a dead-end job, with no prospects of getting the degree I needed to get a better one.

"Then I hit on the idea of buying my own omni, but paying for it by taking out a loan, a mortgage. I sent out the omni to do my job. That job pays enough to make the mortgage payments and cover tuition and modest living expenses. And when I graduate and get that better job, I also will have two incomes.

"It's like being in two places at once, holding down a job and studying. But now I'm scared. With these mobs I'm afraid every day I send my omni to work. I can't even get insurance for it any more.

"You've got to stop these people, Ms. Allison. If I can't use my omni, I don't know how I can go on. . . . "

In the mahogany-panelled conference room atop the U.S. Omnibots plant, three men sat around one corner of the long redwood table. They were oblivious to the large Persian rug under their feet, the centuries old tapestry, and the Monet and Picasso on the walls.

Arthur Adamson, the company treasurer, put down his sheaf of financial reports with a smirk. "I'm kind of looking forward to this. I saw her on the tube last night, and she's not a bad looker. Besides, Carson, she's one of those fuzzy-headed academic types. You shouldn't have much trouble handling her, should you?"

Next to him, Mark Carson, the company's general counsel, put down the phone. "They're on their way." Turning to Adamson and ignoring the other's remark, he asked, "Will they be able to get in?"

Adamson nodded. "Sure, through the old building. Only the new plant's blocked."

At the end of the table, Gerald Boone, president of U.S. Omnibots & Mechanical Vehicles Corporation, sat contemplatively, his fingers idly drumming the note pad in front of him. In the ten years since he had taken over the company from his father, his energy and single-mindedness had made the company the leading world manufacturer of omnibots and related devices. Now forty-seven, still strikingly handsome with some distinguishing touches of gray in his wavy black hair, he had not lost a bit of his restless drive.

"You're pretty sure, Mark," Boone said, "that you've got the Allison woman figured out?"

"Yes," Carson said.

Torchlights and trumpets. Chanting and singing. Thousands milled around outside the almost completed omnibot factory; thousands more paraded around the base of the four square block building. It was a circus, a rally, a religious revival all rolled into one.

Barbara's cab stopped at the edge of the crowd. Showing her credentials to an officer at the police barricade, she pushed through rows of onlookers to stare at the disciplined, striding rows of marchers stretching eight abreast all the way around the megablock.

Her day reviewing records in the Labor Department's Chicago office had not prepared her for such drama. It al-

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most overwhelmed her. If an issue was so important that all those people could come together linked in a common purpose twenty-four hours a day, days on end, could they be wrong?

The stirring trumpets gave way to a drumbeat. The drumbeat gave way to a chant.

Almost with delight Barbara recognized the tune of the railroad song. But the words were different, inspired, desperate:

We won't work on any omni,
Now or any day.
We won't work on any omni—
Get rid of them, we pray!
Can't you hear the omnis coming?
They come to steal your job.
Can't you hear the omnis humming?
Wake up you poor fat slob!
Wake up! Don't you know—
Wake up! Don't you know—
Wake up! Don't you know—
You're throoough
Unless you stop those marching omnis,
Unless we stop those soulless omnis—
By God! We'll stop those cursed omnis!
We'll triumph in the end!

At the conclusion a roar of exultation and determination went up from the mob.

The drums resumed, and the shouting of slogans. In the glare of the torchlights Barbara could see placards held high, blazoning the same slogans that had been so prominent on TV all month.

Fragments of conversation came through the din.

"Twelve weeks without work. My job's gone for good. Gone, I tell you. Those damn omnis!"

"They keep going twenty-four hours a day. They never tire. There's no way I can keep up with them."

"Our savings are almost gone. If we don't win this one, it will be welfare for sure."

Around the edge of the crowd some women were hugging small children, some cheering, some crying softly.

Pushing back through the demonstrators, Barbara sought to come to terms with her mixed emotions.

Deep in thought, she walked around the edge of the crowd to the entrance of the old factory a block away. A guard announced her arrival and escorted her down the long, empty tunnel connecting the old and new buildings.

At the basement entrance to the new building, she was met by the tall, youthful manager of the new plant, James Redfield. He strode forward and extended his hand to Barbara. "Ms. Allison," he said warmly, "it is a pleasure to meet you." He took her arm. "Come, there's time before your meeting. Let me show you the new factory."

When he switched on the lights upstairs, Barbara's breath caught in her throat. She was torn between awe and intimidation at the inhuman vista of acres of gleaming, complicated assemblies of metal and plastic stretching as far as she could see. On floor after floor they passed machine after machine, assembly line after assembly line, and omnibot worker after omnibot worker. She felt as if she were inside some giant mechanical life form. She had goose pimples as she tried to imagine the en-

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ergy and sounds that soon would be pulsing within.

Like a proud parent, Redfield pointed out the special features of the plant and its product. Here is where we make and assemble the treads. Did you know, he asked, that an omni can go up and down stairs at up to a thirty-five degree angle?

Here is where the batteries are installed. An omni can go forty-eight hours without a recharge, and a full recharge takes only eight hours from an ordinary electric outlet.

He showed her how the tentacle-like arms, with their intricate segments, were assembled. He demonstrated how the sixty sensitive pressure pads spread among the "fingers" enabled the omni arm to pick up an egg or thread a needle.

Redfield excitedly showed her the computer-brains, "smart" enough to get an omnibot around by itself, to go from place to place and carry on basic conversations—the hallmark of an omnibot. He listed, though Barbara could not keep track of, the middle-segment collar colors that denoted the power of more complex computer-brains lodged within. The blue-collared bus driver possessed an upgraded brain. Other omnibots, such as the President's secretary, were even more advanced. Still others could be powerfully upgraded to perform even executive level work—their middle segment was topped with a silver ring.

At that thought, Redfield laughed. "Sometimes I think our treasurer worries that he will be replaced by an omni." He paused, "It's possible, you know, and I can think of a lot of people who might like to see that happen. But I don't think Boone would do that to Adamson; they've been together too long."

At tour's end, Redfield glowed describing the new factory's ability to produce thousands of omnibots each week. And the two sister plants under construction on the East and West coasts. And how all those super-efficient omnibots would revitalize the country. And how with volume production the costs of each unit would come reasonably close to that of an auto.

Barbara found herself liking this man and sharing his vision.

Momentarily, she forgot the tumult outside.

They took the elevator to the top floor, where Redfield showed her the conference room. Then he bade her farewell and good luck. "This is one meeting," he said, "that I'm glad I've not been invited to."

She was the last to arrive. Gerald Boone greeted her warmly, led her to one end of the long table, and returned to an empty chair at the other end. Those already seated stared expectantly at the government's representative.

Barbara's gaze swept around the table, returned theirs, and took in the elegant opulence of the room. It did not look like a battlefield, she thought wryly, but then neither did that Gettysburg pasture until the contending armies got to work.

Gerald Boone began. "If we are ready," he said, "I first want to thank Ms. Allison for coming here to help resolve this crisis."

He then went around the table introducing the others. On his left, Mark Carson, U.S. Omnibots's general coun-

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sel. Next to him, the treasurer, Arthur Adamson. Darwin Kent and Steven Goldman from the League for Human Freedom. Rev. Ullman from the Chicago Area Council of Clergymen. Continuing past Barbara and to the other side of the table, Boone introduced Edward Cheng, provost of the University of Chicago and, Barbara reminded herself, another economic historian. Frank Murphy, special assistant to the mayor of Chicago. Then union leaders John Pulaski and Tony Sangster. Finally, on Boone's right, Miles Zenith, vice president of the First National Bank of Chicago.

Barbara nodded acknowledgment.

Rev. Ullman said softly, "Let us pray. Dear Lord, at this critical moment in the history of our nation and planet, as we again confront the conflict between the fruits of the human brain and the dignity of labor, we beseech you for the wisdom to reconcile the seemingly irreconcilable and to restore peace to our lives. Amen."

In the stillness after his prayer, Barbara could still hear through the picture windows the chants of the marchers six floors below, and the glow from the torches managed to cast faint dancing shadows on the ceiling.

Boone cleared his throat and gestured to U.S. Omnibots's general counsel. Mark Carson shuffled through the notes on his yellow legal pad and began, "As the President requested, we have gathered together representatives of the groups most seriously involved in this omni crisis.

"Very frankly," he said, "we are in a bind. The administration has set as the cornerstone of its economic policy the proliferation of omnibots throughout the economy. We at U.S. Omnibots have busted our tails to develop this new technology and especially to build these factories, which are just about ready to come on-line."

Adamson, glancing at Barbara, interjected, "And, if you will look, we have been one of the President's major financial supporters—and hope to keep on being that." The implied threat annoyed Barbara, but she remained silent.

Carson continued, "There are also hundreds of subcontractors and suppliers in thirty-five states who are supporting our effort and are boosting their local economies.

"We simply cannot give up omnis; we need their productivity for our country's future. The knee-jerk reactions we have been seeing will go away in a short time. You, Ms. Allison, of all people, with your particular historical studies, should know this." At the personal reference, Barbara again bristled silently, then smiled inwardly as she recognized in Carson's next words a restatement of the President's basic campaign speech:

"This nation has never gone wrong betting on technology. Giving up omnibots—probably letting the Japanese do it—would be just like our having given up on computers and TVs, consumer electronics, and space flight and superconductors. Look at all the jobs and economic growth those industries created overseas.

"Ms. Allison, the President has got to hold the course, stand firm and back us. U.S. Omnibots can do great things for the country."

"But," Adamson interrupted heatedly, "not unless these dammed riots

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can be stopped. You're going to have to break those unions."

At that outburst a murmur swept around the table, and John Pulaski leaped to his feet. "No way!" he shouted. "You're not going to bust this union. And you're not going to put hundreds of thousands of hardworking Americans out of work!

"People are going hungry out there. They can never be as efficient as an omni. If you replace them with omnis, how can they support their families? Their children? Who will pay for their food, their medical care? I don't care if people are less efficient, they're us. They're what our country's made of. We'll get along without omnis, just like we always have."

Barbara stared at the man. She knew his reputation for integrity. Other leaders might have seized the issue for their own personal purposes, but not, she was now sure, Pulaski.

"Ms. Allison," he said more softly, turning to Barbara, "We have seen no alternative. Perhaps if we had one. . . ."

As Pulaski sat down, Sangster stood. He made it very clear that his union would bring the country to a standstill, if necessary, to keep the omnibot plants from opening.

Professor Cheng spoke up. "Ms. Allison, I, too, have read your papers, and I agree that this problem is not new. We replaced buggy whips. We replaced farmers with tractors. We replaced ditchdiggers with machines. We replaced factory workers with machines and industrial robots. We've always had dislocations, and we've always survived them. We'll survive this."

"I don't know, Professor," said Mike Murphy, the mayor's assistant. "The President claims that omnis alone could boost the gross national product 6 to 8 percent. I'm not convinced that he is right. But even if he is, this omni thing is different.

"Its emotional impact is too overpowering. No matter what you say, if you see an omni working, there is some person not working at that particular job. When you see an unemployed father of four on TV, it is much more real than a thousand graphs showing that in the next four years things will get a lot better.

"Even if the President is theoretically right, the people won't accept that policy. He's going to have to give."

Darwin Kent, Chairman of the League for Human Freedom, slowly pushed back his chair and rose. "You are all missing the main point," he said. "Don't you realize that with omnibots we are on the verge of achieving one of the great goals of humanity—freedom from the need to work?

"History is the story of the search for a shorter work day. Soon, each jobholder will be able to send an omni out to do his job; he can collect its paycheck while he does more satisfying things. We glorify freedom from work as giving us the time to be more of what is essentially human—to be with our families, to participate in sports, to read, to study philosophy, to get an advanced degree or just to learn, to do long-term research without needing to find short-term profits. Just think what creativity could be unleashed if omnis could hold down artists' or writers' workaday jobs."

At his side, Steven Goldman added,

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"For example, and forgive me if this sounds a little stereotyped, just think what a housewife could accomplish if freed from the drudgery of housework. Consider the possibility of sending an omni to work and retiring earlier."

As he went on, Barbara remembered with a smile that earnest young student who had buttonholed her on the street earlier in the day—was it still the same day? The League had a fascinating point, she thought, but it sounded too academic, too utopian, to sell to the public. Which is probably why the League counter-demonstrations were usually so small.

When his turn came to speak, the banker, Zenith, returned to dry facts and passed out supporting documents. "Consider," he said, "the billions of dollars that have gone into the development of omnibots and the construction of these megaplants."

"Big deal!" exclaimed Sangster. "That money came from institutions like yours and fat cat investors."

Zenith responded calmly, "If you throw out that investment, banks won't be hurt; they are just an abstraction. It's their thousands of depositors, stockholders and investing pension funds- people who invested their savings—who will be hurt. They are real people, too, just as much as those on your picket lines."

Like Uncle Mike, Barbara thought.

"And beyond that," Zenith continued, "a lot of entrepreneurs have gotten on the bandwagon. We already have seen the creation of large and small omnibot leasing companies, as in auto leasing.

"There are also the individuals who have purchased omnibots. Many have borrowed to do so. Will you wipe out their initiative and investment?"

"If you do anything to slow omnibot production," Carson interjected, "You will have put an imprimatur on anti-omni prejudice. After the mobs that Sangster and Pulaski are unleashing get through, you won't find an omni still functioning a month from now."

The debate ebbed and flowed, sometimes droning, sometimes bitter. As her own feelings bounced back and forth with each good argument, Barbara struggled to discern any new thoughts in all the rhetoric, occasionally scribbling notes on her yellow pad.

Outside the window a flash lit the sky followed by a dull boom. Amidst the skidding of chairs, everyone rushed to look down. At the far edge of the empty parking lot an exploded, burning car dominated the scene. "I don't see any people over there," Rev. Ullman finally said. "I don't think anyone's been hurt, thank God."

"I think that was just meant to be a message," Murphy whispered.

Gerald Boone grabbed Sangster's arm. "Damn you! Damn you! You can't not have violence, can you!"

Barbara rapped the table sharply. "Gentlemen! Gentlemen! Let's quit that. It gets us nowhere." Everyone looked at her. It was the first time she had spoken all evening.

In the stillness, she said, "We seem to have reached the point of repeating ourselves. Let me see if I can summarize. We have heard good reasons why our investment in omnibots should be continued and why, in fact, it should be

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increased. We also have heard good reasons why omnibots will not and should not be tolerated by our people. I have heard nothing I disagree with.

"What I have not heard is any serious suggestion as to how we can reconcile all these views.

"Does anyone here have any further thoughts on that point?"

There was silence.

"Well," she said, glancing down at her notes, "I think that perhaps I do."

In the Oval Office, the President beamed at Barbara Allison and Mike Fitzgerald. "You did it, Barbara. You really pulled out a miracle. An absolutely inspired solution. Isn't it, Mike?"

Fitzgerald also smiled, "It surely is. Barbara's insight seems so obvious in retrospect. In earlier technology changes, each new factory displaced large numbers of jobs. But individual omnibots replace workers only one or two at a time.

"So, what you are proposing is that the only omnis that can be put to work are those owned by individuals. If a factory wants to use an omni, it has to get it from a worker who owns one or has leased one from a leasing company. This worker would get the omni's paycheck and would not feel displaced. We can insure that existing employees have the first right—over a non-employee—to supply an omni."

"Right," the President agreed. "In addition, the omni-owning worker becomes a small-scale capitalist, a neat turn of events."

Fitzgerald asked, "But we expect our economy to use millions of omnis. How will we get enough omnis into the hands of millions of workers?"

"The same way," Barbara said, "that we get automobiles into their hands. They will take out loans or lease them. The banking and leasing industries have the experience and incentive to develop such a huge new market. They simply will deal with many individuals instead of with a few companies. Unit costs should be driven down by the large market both for new omnis and for upgraded omni brains capable of better jobs. The sales will repay the large investors and lenders who financed the omnibot factories."

Fitzgerald knitted his brows. "What if industry needs an omni in a particular place and can't find a person with an unoccupied omni?"

"Well," said Barbara, "they'll find a person without one and offer him enough money to make it worth his while to get an omni and send it to work for the company. It will be a long while before everyone has an omni." She paused. "I'm not sure what we'll do if a worker likes his job and does not want to get an omni even though he will have more leisure and the employer will pay for it, but I think that's a minor wrinkle.

"I also would expect that eventually there will be pressures for an almost all-omni work force. But I guess we can leave that matter for the next generation."

Fitzgerald said, "Your second secret to using omnibots without dislocation, at least for the near future, is *not* to insist on getting the *maximum* efficiency out of them, *not* to let them work twenty-four hours a day."

"And the final principle," said the

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President, "is that we can't allow a person whose omni has a job to become an employee at another job. That would be the same as if the omni itself replaced the holder of the second job. However, there would be an exception for a person with a working omni to become *self*-employed. That does not take a job away from anyone else. In fact, it would encourage that person to become an *employer*, which will create even more jobs and a bigger economy."

Barbara nodded. "I'm sure there will be some problems, but this compromise allows a widespread but gradual introduction of omnibots."

"And," said the President, winking at Fitzgerald, "saves U.S. Omnibots's stock and bondholders."

"That, too," Barbara said, then added, "We'll let the lawyers work out the statutory details, but the underlying idea can be summarized in just three principles."

She handed Fitzgerald the torn piece of yellow paper on which she had hastily scribbled while in Chicago:

"FIRST PRINCIPLE: ONE PERSON, ONE OMNIBOT! Only individuals may own omnibots, and an individual may own only one omnibot at a time." "SECOND PRINCIPLE: ONE OMNIBOT, ONE JOB! An omnibot may work only one job and only for the same hours as a human doing like work." "THIRD PRINCIPLE: ONE OMNIBOT, ONE WORKER! A person whose omnibot is employed may not be employed at the same time."

As Fitzgerald finished reading, the President rose and came around his desk to Barbara. The President took her hands as she tried to stand up, and bent down to her forehead.

It was the first time she had ever been kissed by a President. ■

●It is not enough to have a good mind. The main thing is to use it.

Descartes

●The pace of events is moving so fast that unless we can find some way to keep our sights on tomorrow, we cannot expect to be in touch with today.

Dean Rusk

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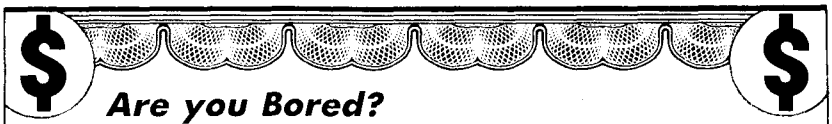

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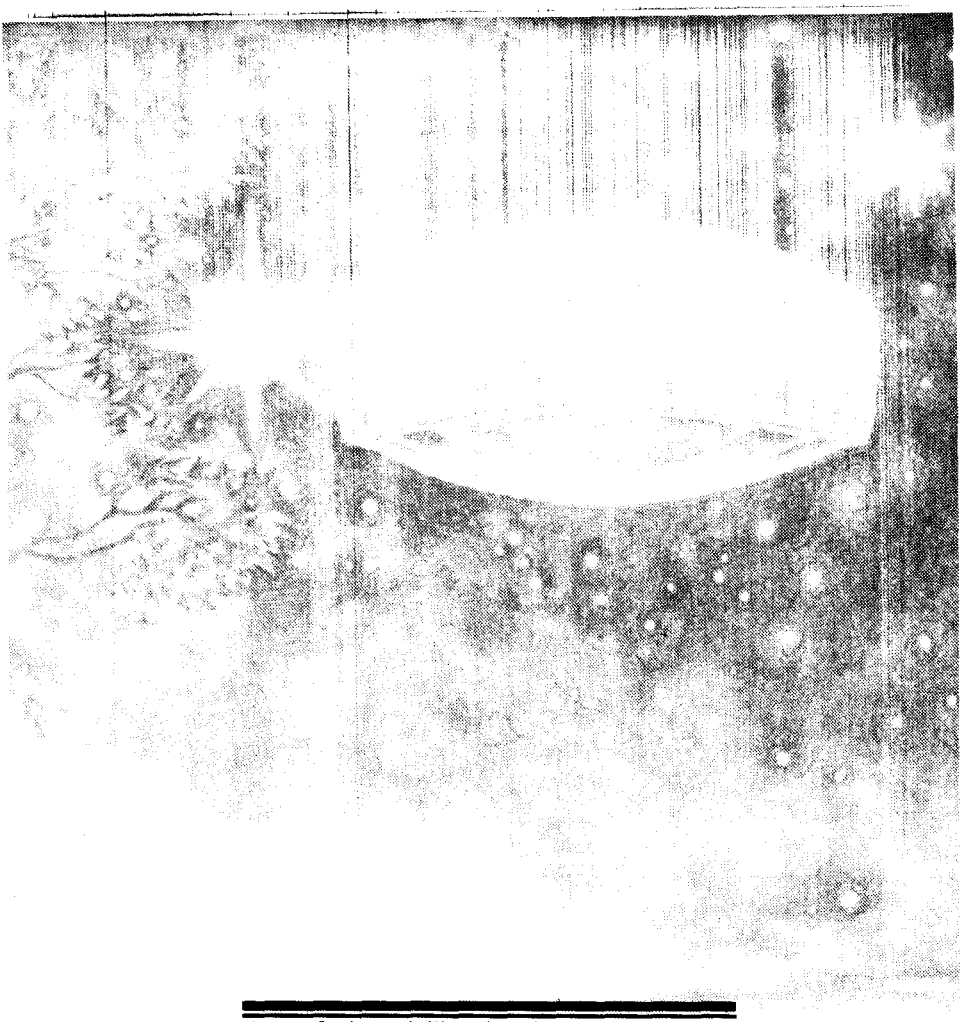

A starfaring civilization is a grand vision,
of great ships plying interstellar space.
But to most people living in one,
it might look rather different. . . .

Dell Harris ©1990

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The spaceship came down over Port Michigan. Bobby Wilson sat up on Melancholy Heights, where he had been lying in the clover. He caught his breath; he looked again where he had lain dreaming over the town's steeples and hot sloping roofs nestling amid the green cotton candy of the trees.

Yes! A ship coming down, throwing back the rays of Columbia's warm sun, and growing, growing! It was as big as a baseball, but a fat sausage in shape. Bobby yelled.

"Starship!" He leaped to his feet. "*Sta-a-arship ho-o-o!*"

Bobby leaped and cavorted on his high green hill, pointing, shouting. His voice went echoless away from the Heights.

The sheep looked up briefly, glanced quizzically at each other, and shook and slatted their ears about their heads. It's only the boy, shouting again. Never mind *him*.

Spike and Tyke, the dark sable Cross Collies, arose and looked south, tongues hanging, bobbing and dripping, looked down on the town, on the Michigan Sea sparkling beyond. Puzzled, they looked back at him. Finally they saw the ship. They watched it, ears up, interested but not excited.

Hearing Bobby's yells, a few birds flew up. Rabbits, too, raised their semaphore ears, swiveled them about, then lowered them, their alarm short-lived.

The ship grew to a cloud, a solid silent drifting cloud of scarlet and gold, blown on a wind where no wind blew, sideways and down, sideways and down.

"It can't be *Annis*," Bobby told the dogs, excitedly. They glanced at him, pulled their tongues in, gulping.

"*Annis* isn't due for four months, not till after school starts," Bobby said. *Annis* was the annual ship of the Far East Colony Circuit. "And it can't be *Golightly*; they don't expect it for six months."

He stood staring in awe as the massive construction came down as lightly as dandelion-fluff.

"So it has to be a tramp. A star-hopper!" Bobby leaped again into the air, yelling his loudest. For what greater felicity could a boy wish, in his twelfth summer, than a tramp starship?

Like the wind, tramps went where they willed. They were novelty, glamour, adventure. They were the *stars*.

What a time for the boys and girls in Port Michigan! Now, down there, they were running south toward Starport Bay, like children following some pie-eyed piper, their dogs running and barking with tongues hanging out. And the grown-ups also were pulled by the gravity of the Bay toward the south, walking of course, but walking fast. All Port Michigan was flowing south, to stand staring and pointing and calling out on the wharfs.

A starship, a tramp! Bobby thought of John Hennessey, who stowed away on *Bedelia* twenty-one years ago, and of Ryan Atteborough, who stowed away on *City of New Beijing* twenty-eight years before that. And others he named who had gone to school, to distant jobs, and had never come back.

And down the great ship came. Its mighty shadow passed across Port Michigan and all the steeples and roofs

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and treetops went dark. The great scarlet and gold cloud came down upon its shadow, smoothing all the waves. Bobby let out a long-pent breath as the great ship rocked, belly-deep in the waters of Starport Bay. "Down! She's down!"

Not only Port Michigan moved toward Starport Bay, Bobby knew. From the east and the west and the north, the special trains were flying. Ships were leaving harbor in a dozen towns along the coast, making their way to the planet's starport.

Bobby glanced at the sun and groaned. It would be hours until it was time to bring the sheep in. Hours in which all the other boys and girls in Port Michigan would line the wharves, beg rides on the lighters, even speak to shipmen! And here he stood on Melancholy Heights, watching the dogs, who needed no one to watch them, watch the stupid sheep, who scarcely needed the dogs.

"It isn't fair," he told the dogs, plopping down suddenly. "The only week in the whole summer I have to herd sheep."

His voice trembled; tears threatened. No wreck of a grown man's hopes can be more poignant than a boy's loss of *a ship*.

At last the sun set, and the Cross Collies brought the still-grazing sheep down the slopes. Bobby Wilson hurried the sheep into the fold and ran around to the office.

"Mr. O'Kelly! Mr. O'Kelly!"

The old man wasn't there. Bobby pounded on the door, but the old man still wasn't there. Finally, with a sob of impatience, he went in, Spike and Tyke dancing around him. Bobby got down an earthen crock. Warm dry meaty odors arose as he lifted the lid.

"Where's your bowls? Oh, here they are."

Hastily he scooped out mounds of red-brown, dry pebbles, dumped them into the heavy earthen bowls. The Cross Collies sat on the floor, craning their necks to see, glancing at each other in embarrassment.

"Outside! Outside!"

He caught up a bowl in each hand and staggered to the door, the weight of the bowls pulling at his wrists. Outside, he set the bowls down. Politely Spike and Tyke waited for him to invite them to eat.

They watched till he had turned the corner and was out of sight, then looked after him, prick-eared, till his footsteps faded. Apologetically each looked at the other, approached the bowls as if idly, looked around. Then, embarrassed, each ate without invitation.

Not even the first ship to land this year could keep the grown-ups of Columbia from their suppers: roasts, fried chicken, sweet corn, biscuits, cakes and pies and ice cream. Bobby Wilson ran through the aromas of these things.

The boardwalk gave back muted thunder beneath Bobby's feet, rumble rumble *slam*, rumble *slam slam*, rumble rumble rumble *slam!* He jumped with both feet on every loose board, and knew them all. Elm Street, Maple Street, Oak Street, and Cherry. Down Cherry Street Bobby pelted, panting.

"Ho, lad!"

Panting, Bobby peered at a tall, slim, elegant figure. His school teacher, Mr. Ladysmith.

"Ah, Bobby Wilson." The teacher

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looked young till you saw the lines at eye and mouth. "I trust you have not been improving the shining hours this day, nor indeed this summer. But of course it is too much to expect you to keep up with your summer studies with *Rosa* in port. I will uphold awhile the unyoked humor of your idleness, lad, but I shall expect your echo to answer cheerfully when it comes time to write you down as one who mourned not his unwasted youth."

Grown-ups were hard enough to understand; Mr. Ladysmith was impossible. "Yes, sir," Bobby said at random.

"I fear I waste your time, Bobby. For a boy's will is the wind's will, and the thoughts of youth—but I forebear." The elegant teacher saluted him with a tip of his straw boater.

Bobby looked after him wonderingly. But home was near.

Bobby ran. In at the Wilson gate, his feet slapping the flagstone walk, up to the porch, bump-bump across it to the front door. He threw the screen back, fell through the front door with a crash, the screen slammed, the front door swung, left open. He ran through the living room, slap-slap-slap, through the food-odored kitchen, back through the dining room, through the parlor.

The house was empty.

He ran panting back to the kitchen, where he found honey-glazed ham in the oven of the porcelain stove. Potatoes bubbled in one pot, peas in another, and yams steamed in one steamer and string beans in the other.

Bobby ran to the back door. "Teddy! Teddy!" Even his dog had gone to see the ship. *Rosa*, Mr. Ladysmith had called it.

Bobby ran across the Wilson yard, around the lilac into the Hardesty yard, avoiding the dimly-seen rosebush in the gloam, and checked. He could see no one in the kitchen of the Hardesty house. He ran around it, and saw Uncle Mordecai lighting the gaslights at the yard gate.

"Uncle Mord, Uncle Mord!"

The old man turned slowly. "Bobby. Thought it was about time you were gettin' in." Carefully he scratched a match, twisted the stopcock, held the match to the slow rush of gas. Soft yellow light lit his lined face, his white hair and mustache and neat beard. A moth hurried up. He brushed it away and replaced the globe.

"Where is everybody, Uncle Mord? My family and your family—"

"They're all down at the wharfs, greeting the shipmen."

"It's suppertime!"

"They'll be back any minute now. We've got the doctor coming to supper, and your family is entertaining one of the lieutenants, I think. My granddaughter Annie will be eating with you. Listen."

Bobby strained his ears, and heard over the crickets the muted happy babble of conversation. A large family party approached.

"Oh boyoman!" Bobby ran back past the Hardesty house, past the rosebush, and around the lilac. Teddy came running into the back yard, panting, and leaped up at him, the harbinger of the family.

Lieutenant Ricardo Montoya was slim, had ageless good looks and wore an elegant light-lemon uniform. He had

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amber skin, brown eyes, and raven black hair. And he was a *shipman*.

Lt. Montoya was visibly embarrassed at being the center of attention. Father and mother, daughter and son, grandmother and cousin, all gave him their attention. He ate little.

"We should have no trouble making up a cargo for you," said Mr. Wilson with relish, as if he were on the board of trustees of the planet. "We've got ten thousand tons of radiation-preserved apples. And a hundred tons of preserved fruit pies."

"Tell me, Lieutenant Montoya," said Bobby's older sister Sharon, leaning toward the shipman like a flower toward the sun. "What do you think of Columbia?"

"Oh, call me Ricardo, please, or Rick, Señorita—er—Miss Wilson." The lieutenant blinked in alarm. Bobby's cousin Annie also leaned breathlessly forward, though she was older than Sharon.

"Oh, thank you, Ricardo! Please call me Sharon. Do you call women Señorita on your ship?"

He smiled apologetically. "I fear Espanyol is no longer spoken on Nuevo America. But yes, we still say Señorita for Miss, and Señora for Mistress, and Señor for Mister, and we add Don to most titles. Don Capitan, for instance, no?"

"Don?" Bobby's mother asked. Mr. Wilson's name was Don.

"An old espanish word meaning Lord." Ricardo managed to swallow a bite of ham.

Bobby laughed, looking at his father.

His father frowned back at him. Bobby sobered instantly and made sure he was not gobbling his food, or resting his elbows on the table, or committing any of the other sins that so provoke grown-ups.

"You never said what you think of Columbia," Mr. Wilson said.

"It looks more like old Earth than any planet I have seen," Lt. Montoya said. "The trees, the birds, the flowers, the grass."

Mr. Wilson expanded. "The Founders discovered Columbia early in its biological evolution. There are only a few reedy native plants, and some sea creatures. So we imported Earthly life."

"Tell me . . . Ricardo," said Sharon breathlessly. "What is it like on New Waybo America?"

But the lieutenant's reply was diverted by Mrs. Wilson's offering of more ham.

Bobby gulped his own ham, his imagination at work on the lieutenant's home planet.

A strange place. Different from Columbia. The sun, maybe, rose in the west, or in the north or south! Snow fell in summer and it tasted like mint! In autumn, the leaves flapped and flew away south in flocks, clouds—red, yellow, tiger-striped, never to return! Flowers glowed at night, and fireflies came looking for them. Bees made fruit custard instead of honey, and all you had to do was freeze it to get ice cream!

If he, Bobby, lived there, he would never leave. He looked at Lt. Montoya in amazement. How could he bear to leave such a place, especially for dull old Port Michigan?

"Bobbeee! Bobbeee! Coooeee!" The calling voice broke on the last note, shattering it into ten thousand pieces.

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Bobby started. "It's Philly!"

He started to jump up, but his father said, "Drink your milk, Bobby! And excuse yourself from the table."

"Sorry, Dad! Momma, Philly's callingme, canIgo?"

"*May* I."

"MayIgo?"

"Very well, you may go."

Lt. Montoya smiled at him, perhaps wishing he might go also, to play in the warm summer dark under the old trees of ancient Earth.

It is not wise for pirates and financiers and suchlike desperadoes to meet in the glare of the street light; rather, they should seek the darker corners of the yard. Thus it was that Bobby found Philly in their usual place, an arbor of shade trees and shrubs.

"Oboyoman! You missed the ship!" Philly cried. "It's named *Rose* and it's from New Wavo Something! Jan 'n' me went 'n' watched it."

"I saw it come down," Bobby said. He was subdued. "It was great. It's named *Rosa* and it's from New Wavo America. We ennertained Lootenant Ree—Reecartho Mon-toy. My stoopid sister Sharon's crazy about him, and so is Annie."

"Wow, your family was lucky. A shipman! My Dad tried to invite one, but he was too late." He changed his tone abruptly. "You're still herdin', ain'tcha?"

"Yeah, 'nless I can get out of it."

Philly frowned, hardly seen in the shadow. "I dunno. *Nobody's* gonna want to herd stoopid sheep when there's a ship in."

"I been thinkin'," said Bobby. "There's that feeb Chris Brinker."

"She's too dumb to play with anyone," said Philly. "But," he added doubtfully, "will she want to miss the ship?"

"It's not my turn for two weeks!" Chris Brinker cried sturdily. "I wouldn't trade with *you*, Bobby Wilson, if you was to beg me with bended knees! Not if you was to beg me a hundred times with bended knees with sugar on it! It's your turn, you little feeb! So there!"

"You dumb feeb! You couldn't have fun with a ship in port anyway," Bobby cried desperately.

"Teacher's pet! Teacher's pet!" Philly joined in loyally. But it was no good.

They tried lanky Joe Finkle, who hooted hysterically at them, and short dumpy Rachel Dyakov, whose negative was physical assault, and Mike Atteborough, a brown older boy who smiled scornfully, and BeBe Feder, who sicced her poodle on them (he played with Teddy), and Diana White, whose mother said she had gone to bed.

And now all about them in the night the mothers were calling their children home, their voices variously patient, wistful, or exasperated, yet always melodious with love. The echoes tolled across the town, tolling the children home. Reluctantly they drifted away from their groups gossiping in darkness, each telling the other what he or she had done that day and would do the next: John Hennessey and Ryan Atteborough were dismissed as pikers.

Bobby Wilson and Philly Wu drifted homeward, toward their own tolls. At his door, Philly was charged severely by his mother with lateness. Knowing

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he would receive no warmer welcome, Bobby did not hurry.

"Bobbywherehaveyou *been!* It's bedtime. Off with you!"

"Momma," he said. "Momma!"

"Yes, Bobby?"

"Momma," he said desperately. "Can I skip the herding tomorrow? Can I, Momma? Please? Mr. O'Kelly could go! Please, Momma?"

"What? No, Bobby. Mr. O'Kelly can't go, he has to oversee the sale of the town's wool to the shipmen. Maybe you can get a substitute tomorrow night, and stay home the day after."

But the day after tomorrow is ten years from now, a hundred, a thousand! when you're twelve. Bobby broke into tears and ran through the house, slapslapslap, burst through the screen door slam *bang!*

"Teddy! Teddy! Where are you?" Teddy was the pillow he always wept on. But the little black and white dog thought he wanted to play, and Bobby had to pursue him into his cousins Hardesty's yard and tackle him before Teddy understood.

He lay then, panting and whining companionably while Bobby wept on his long fur. His tail thumped the ground with misplaced cheerfulness. The night was rich with the scent of dew, of flowers; rich with the scent of old summer.

Uncle Mordecai found him there. "Trouble, Bobby?"

Sniffing, gulping, Bobby wiped his eyes on the little dog's fur. "I—I have to herd sheep tomorrow."

"Oh. Yes, this is your week."

Uncle Mord sat down slowly, picked up a stick, broke it. "The ship couldn't have picked a worse time to planet in," he said.

Sniff. "No." Sniff.

Uncle Mord sighed. "Bobby, I'll go up tomorrow; you have fun."

"Oh, Uncle Mord! Oh, would you? Oh, Uncle Mord!" Tumultuously he hugged the older man. Teddy leaped to his feet, barking in relief.

"Easy, easy, lad. Yes, of course I'll do it. I know how boys and girls are about ships. Yes, lad," he said musingly, removing the boy's arms from about his neck and taking him on his lap. "Old though I be, I understand."

"Mr. Archer, the Last of the Founders, died nineteen years before I was born," said Bobby. "Covered with years and honors."

"Covered, as you say, with years and honors," said Uncle Mord gravely.

This phrase, to Bobby, conjured an image of an old man with white hair and beard tottering along the street —"covered with years"—greeted with bows and smiles, to which he responded with a flourish of his stick and a lift of his hat, like Mr. Ladysmith —"covered with honors." Bobby had often wished to be that old man.

"Have you ever been covered with years and honors?" he asked.

Uncle Mordecai grunted in something like amusement. "With years only, I fear."

"Anyway, you'll take my place tomorrow? You don't mind."

"Yes, I will. I shan't be bored. I'll take along my knives and the current project. A little something for you, perhaps."

Uncle Mord carved wood. He carved chains, and cages with birds in them,

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and door knockers with comical faces whose eyes rolled when their broad noses were struck. He carved windmills and ancient airplanes. And he carved toys. He was famous among children for blocks around, and they covered him with honor.

"Oh, yes, golly, thanks, Uncle Mord."

"Bobby? Bobby? Where are you, Bobby?"

"Coming, Mom! ThanksUncleMord Igottago."

The next morning Bobby Wilson's sister Sharon rose early. He heard her singing in her room and remembered: a ship was in! The *Rosa*, the *Rosa*, the *Rosa*, of New Something! He scrambled into the clothes he'd worn yesterday, and ran bammity bammity bam downstairs and across the yard and past the lilac and around the rose bush, and in the back door of the Hardesty house.

"Aunt Kate, Aunt Kate!" he cried. "Did Uncle Mord go up the Heights today?"

Nobody had called him. If he was to herd sheep, he was late; the sun was already beginning to pour level rays of heavy light across the roofs and treetops of Port Michigan.

"Hush, you'll wake your cousin Annie. Yes, Bobby, he left before sunup."

"ThanksAuntKate! Bye!"

He shot back across the yards, through the kitchen, into the living room. His father sat there, reading the Port Michigan *Newsbreak*. He glanced up in irritation at Bobby, then looked with even more irritation toward the door of the parlor. Music came out of it.

Sharon was playing the stereo horn there and dancing dreamily. "That's a very good sign, that he's your tootsie-wootsie, in the good old SUM-mer time," she sang. She twirled about, her lace-white skirt swirling, and did not see Bobby, he not being on the ceiling.

"A hopeless case," Mr. Wilson said gravely. "Extremely contagious. One exposure and she's down with it. One shudders."

Bobby nodded. Sharon was in love again.

"I'll be with you in a-ap-ple blossom time," Sharon sang, waving her fingers. "I'll be with you, to cha-ange your name to mine."

"Go ahead and stare at her. She won't notice," said Mr. Wilson. "She won't hear anything you say either, the condition makes her deaf. We could charge admission. Rare specimen of a young girl in love."

"Breakfast is ready."

Bobby arrived at the table at a dead run. Mr. Wilson folded his paper and walked in with dignity. Grandma Bartram came in, went out, came back leading Sharon, still dancing.

"Mmm mm-mm mm ooomm mmm," Sharon hummed, preferring sound to sense. Mrs. Wilson slid a plate of pancakes under her nose. She sniffed its aroma dreamily.

Mr. Wilson stared at her. "I suppose your cousin Annie is over at the Hardesty house, in a similar condition," he said.

Sharon poured maple syrup delicately over her pancakes. Bobby saw that she was trying to write "Ricardo" in syrup. But when she had done, she did not eat the cakes, only dipped up some of the

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syrup and sat dreamily tasting it, syrup sweet as anticipated kisses.

"Your Uncle Mord should have taken her up on Melancholy Heights," said Mr. Wilson. "Spike and Tyke could look after her."

"Oh, hush, Don," said Mrs. Wilson. "You were young yourself."

"Young, yes; a young woman, no; a foolish young woman, never."

Mrs. Wilson looked at Grandma Bartram. "I think I can remember a few foolishnesses," said Grandma. "Like the time you tried to stow away on *Annis*. You ran around with John Hennessey too much."

Bobby knocked his milk over, but he caught the glass and only spilled half of it. "Oops, sorry," he said, and jumped up for a cloth. When he had mopped up the milk and washed out the cloth, he sat down and they were all looking at him. Except Sharon. She was looking at the ceiling.

"I gotta go meet Philly," he said hurriedly. "May I go? Please?"

His parents exchanged glances and his father said judiciously, "I believe that we can permit that. Perhaps even encourage it."

Bobby ran out and grabbed his bike. Into the Wu yard, around the back door.

"Philly! Philly!"

Inside he heard an altercation, and Philly came running out. Behind him his mother was wailing, "You didn't finish your breakfast!"

"Let's go!"

They mounted their getaway bikes and escaped the scene of the crime. "You're not herding!" Philly cried joyfully.

"Got Uncle Mord to go!"

All over town boys and girls were pedaling, converging on the docks. Here Bobby and Philly met the third of their usual trio, Jan Conway.

All night the specials had come hissing in, and the ships, too, had wallowed into Starport Bay, and still they came, with the goods which *Rosa* would carry to the stars. Men packed bales and barrels and boxes tightly away in shipping containers, which were lifted by crane and lowered into lighters, then lifted again into the cavernous echoing holds of the great starship.

And the children were there. Bobby and Philly and Jan rode a lighter back and forth, falling into the water and then fished out, laughing. They got in the way of the sweating men packing containers on the wharfs and were chased away with oaths and laughter. Everybody laughed, everybody worked and sweated, many sang as they worked. Some sailors from Superior City invited them aboard ship for lunch and they ate ham sandwiches and pickles and smoked fish and hardtack.

Until Jan remembered that the *assistant purser of the ship* was invited to her house for dinner! She jumped up and ran dithering around the deck for three minutes, but there was no way ashore, and no time. So she sat down with them again and ate pie mournfully and stuck out her peach-coated tongue at everybody who laughed at her. . . .

Bobby Wilson, Philly Wu, and Jan Conway trailed their bikes tiredly home as the shadows lengthened.

They parted at Bobby's house. Bobby dropped his bike on the new-cut grass, to be greeted exuberantly by Teddy, who had been left whining on the wharf.

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Sharon wadded up a ball of grass and hurled it viciously at him. Barking in delight, Teddy raced around her wildly.

"I have always hated that feeb Esmeralda Wu!" Sharon declaimed intensely. If she had not always hated her before, she had always hated her now. "Do you know what she's *done?* She got that snake-in-the-grass *father* of hers to go and invite *Ricardo Montoya* to supper!"

Sharon hurled more grass at the dancing dog, but he was too fast. She chose instead a slower-moving target, the tree by the gate.

"She lives in storm and strife," said Mr. Ladysmith, unseen till now, leaning over the gatepost. "With banneret and pennon," he continued, "trumpet and kettle drum, and the outrageous cannon."

Sharon stood balancing a grass ball in her hand, contemplating outrages and cannon. Mr. Ladysmith glanced at Bobby and said, "Ah, but the thoughts of youth are long, long thoughts. And the wind, it bloweth where it listeth." He took off his hat to Sharon.

To Bobby he said, "I fear that I bear bad tidings from Ghent to Aix. The City Council of Trustees will need your uncle, Mordecai Hardesty, to help decide which of its stored goods and chattels it should sell to *Rosa*. So you will be forced to take the sheep up again. You have my sympathy, lad. I shall see thee at Philippi." And he went away, swinging his hat, covered with nothing.

Supper was not a pleasant meal at the Wilson house. Bobby ate mechanically, but food did not fill the hollow within him. And only the nudgings of her mother prevented Sharon from putting her head down on the table in adolescent despair.

Bobby wept in the gloaming on Teddy, and was not consoled by Uncle Mord's apology. He had to be called three times, last by Sharon, who jerked the pillow viciously from beneath his head, declaring she was fed up with hearing her mother yell at him. He went heavily downstairs, and heavily ate without tasting, and went heavily off.

Mr. O'Kelly said, "Oh, there you are." Spike and Tyke accepted him with some reserve, moving the loud sheep out with wary glances over-shoulder at him: the boy would have let them starve.

When, however, on Melancholy Heights, he broke down and sobbed with the abandon of a small boy, the dogs gathered round, perturbed. They whined and nuzzled him until he seized Spike, flung him down without any respect for his sheep dog's dignity, and wept on his sleek side. Spike looked in consternation at Tyke, who sat looking back with droll astonishment.

When he was not weeping Bobby lay on Melancholy Heights, chin upon crossed arms, and meditated on John Hennessey, who stowed away on *Bedelia* when his father was young, and on Ryan Atteborough, who stowed away on *City of New Beijing* when Uncle Mord was young. And never came back. And never came back.

Bobby had no use for Connie Maplethorpe, the girls' heroine, who married onto *Merimna* seventeen years ago. Everybody knew that a shipman woman who married a planet man would most likely settle on the planet, like old Mrs. Ping Ping Norton.

How could they give up *stars?* Bobby

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yearned for stars, stars wheeling by the ship's ports. And planets, not like dumb old Columbia, planets of wonders and delights beyond the imagination even of small boys.

And so the days of that glorious and mournful week passed, days Bobby languished on his green hill. Once Lt. Montoya came to dinner, and that noonday Sharon Wilson was in heaven; there was not even Annie to compete for him, for she hadn't told her cousin of his visit.

Came the evening of the day before The Day on which *Rosa* was to depart. The children stood on the end of the longest wharf, looking hungrily out at the great scarlet and gold bulk bobbing slightly.

"John Hennessey," Philly Wu asserted, "fixed up a container with a bed an' a box of food an' a light! He was loaded aboard just like any ole container, and stacked! Nobody ever knew he was there till *Bedelia* was gone two weeks."

"No he didn't," Jan Conway said. "No he didn't."

"Then what did he do, you know so much?" Bobby asked.

"He rowed out at *night* and climbed a *rope*," Jan said. "My goodness gracious, you make up the biggest stories, Philip Philadelphia Wu!"

"John Hennessey was sweet on a shipman girl, and she helped him sneak aboard," little Rachel Dyakov asseverated loudly. "Everybody knows that!"

"I don't know it!" Bobby said. "I don't know it!" And when Rachel seemed disposed to urge her view, he drowned her with further repetitions.

"Then what *do* you know?" the even-tempered Jan was driven to ask.

"Yeah, you're so smart, Mr. Big Wilson, what do you know?" Rachel Dyakov cried, making fists and visibly preparing for assault, her normal mode of communication.

"What do *I* know? What do *I* know? Whose *father* used to *run around* with John Hennessey, I'd beg to ask! That's all I'd beg to ask, just whose *father*—" Rachel attacked and he was forced to hold her off.

"Well, anyway, Ryan Atteborough stowed away in a container," Philly said, raising his voice over this polite converse. "I know mighty well *somebody* did, and if it wasn't John, it must've been Ryan."

Exhaustion ended the argument, and despair; even Rachel scarcely had the energy to pummel people bigger than herself.

"Gonna be quiet around here when that ole ship is gone," Jan murmured.

"Ole Starport Bay's gonna look mighty empty," Philly said.

"They're not lifting off till tomorrow night," Bobby said.

"Not till after dark," Rachel added, eyes gleaming.

The others nodded. "Yeah. Gonna salute'em takin' off with good ole Founders' Day fireworks!"

"Yeah! I'm gonna be down here first thing, right on the edge of this ole wharf, front row seat, yes sir!"

An argument over who was going to be first, and first of the first, and on the edge of the wharf, and on a boat in *front* of the wharf, and on the *bow* of the boat, was interrupted by the melodious lovely calls to suppers.

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As they wended homeward, Bobby's spirits sank. They passed through the warehouse district back of the wharfs. These aging buildings were made of a peculiar dull-gray brick with black speckles, the cheap native brick of Port Michigan. From a distance they had a characteristic dull color that was now, to Bobby, the very essence of all mundanity. Tomorrow The Ship would depart, taking with it all the magic of the world.

He would grow up dumb and satisfied, like the sheep, and marry someone who had never wanted to go far far away, and would live bored forever after on Columbia. Walking toward home, Bobby hated the warehouses, the bricks of which they were made, the clay from which the bricks sprang, and the scrawny, dusty, every-day weeds that grew in the spaces between them with such an intensity he could not begin to express it.

At the top of the street they turned for a last look at The Ship. Only one more day, Bobby thought, and he must miss it!

On his front porch, Bobby found Sharon abandoned at full stretch on the floor before the door. He paused, alarmed until he heard her sniffle.

"Out of the way, feeb, you're blockin' the door," he said.

"Go away," she said dully, not moving.

"How *can* I go away when you're in the way? You're blockin' the dumb door!"

As if with great effort, Sharon muttered something that ended with, "other door."

Bobby was too tired to walk all the way around the house. He knew that he would just absolutely completely die if he had to walk so far. His legs felt like lead weights.

"You don't haf to lay here!" he cried. "You could lay on the grass. You could lay on the porch swing. You could lay on the roof! You don't haf to lay all the time in the way like you always are."

She raised her head from her arms and looked at him with wrathful, teary eyes. "Oh go away, Mr. Smart-aleck-Bobby-Wilson! Go play with the dog!" And she bumped her head back down again in despair.

"I *can't* go away," Bobby said, his voice cracking in irritation. "You're still in the way, feeb!"

With that he stepped on the small of her back and tried to open the screen door. Sharon made no effort to resent this liberty with her sorrow, except to roll slightly toward the door, further frustrating his attempt to open it. It banged against her jeans-clad hip and Bobby cried, "You're too *fat!*"

Even this insult did not animate her. She merely sniffed and turned her head to watch his efforts scornfully. Stepping down into the narrow space between her and the wall, Bobby opened the screen as far as it would go and tried unsuccessfully to wriggle behind it. Rolling further, Sharon applied so much pressure to it as to render him red-faced and pop-eyed with effort.

"Hold still, can't you, you ole thing, you!" he cried wrathfully.

Crouching, he tried to roll Sharon away from the door, but his hands slipped and he sprawled across her with a grunt, eliciting nothing but a scornful, satisfied "Huh!" from her.

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"It was a shocking sight, after the field was won," said Mr. Ladysmith, at the gate. "For many bodies here lay rotting in the sun. But things like that must be, after such a famous victory." He approached, mounted to the porch. Bobby pushed himself off Sharon and knelt between her and the door. Sharon was too far gone in despair to care how she looked; she returned Mr. Ladysmith's gaze sullenly, craning her head back over her shoulder.

"I have come," said Mr. Ladysmith, seating himself on the porch swing, "to talk of not very many things. Not so much of shoes, or sealing wax, as ships. Or the ship."

Mr. Ladysmith swung a few centimeters back and forth, with immense dignity. "Bobby, my lad, you are one of my pupils, or would be if you were a student. A place has been set aside for the school children—in my opinion, to keep them quiet—where they may watch the farewell to the shipmen. I believe we shall be seated on Mr. Slatter's flatbed truck. A few selected scholars will be called upon to recite short poems in farewell—fear not, you have not been singled out for this dismal honor. The mayor of our fair city, and the chairman of the board of trustees of Columbia, will not be restrained from making speeches, and I presume Don Capitan Cardenas will be forced to reply."

He looked at them with lifted eyebrow. "After which, the good shipmen will be conveyed back to their ship, and *Rosa* will depart through a cloud of leftover fireworks. Of which, again, from the truck bed you will have a good view. Is this not felicitous?"

Bobby debated. "I guess so," he said sullenly.

"I shall expect you then, on Main Street wharf at the appointed time. Ah, but tonight, all is depression, darkness, and desolation. Parting is such sweet sorrow. I know I can in no way console you, or abate a jot of your despair. Yet, I cannot forebear; the thoughts of youth are long enough, and to spare."

He stood slowly; the swing creaked once in relief and was silent. "As you get older (it is no consolation now) your hearts will come to such things colder. Then, you may weep, but will know why: this is the blight we are born for; it is ourselves we yearn for."

He descended to the walk, then turned for a murmured antinomy. "That is, if you should grow up. That is not a common fate."

Bobby and Sharon arose, disconsolate, and entered the house. "At least," Sharon said resentfully, "that nasty Esmeralda Wu didn't get him either." Flinging herself onto the couch, she said dreamily, "Everybody would have loved him so much."

"If you really think he would have done it!" Bobby exclaimed. "*I* wouldn't jump off a ship for some dumb ole girl!" Sharon didn't deign to answer, but he hadn't time for her anyway. He hurried over to Uncle Mordecai's, where Annie had already slumped off to bed.

"It's the last day," he said, despairing.

"I know it is, Bobby, but I really am tied up all day." Apologetically, the old man offered: "It's human nature. We want what we can't have, and can't want what we do have. I wish it could have

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been me, instead of Ryan Atteborough."

Bobby looked at his white-bearded relative in amazement. "Did *you* ever think about stowing away on a ship, Uncle Mord?"

"I think about it every time one planets in," said the older man gravely. "I have always yearned for the stars."

"Mr. Ladysmith says we yearn for ourselves."

"What would Mr. Ladysmith know?" Uncle Mord said, irritated. "*He* never yearned. But neither Ryan nor John stowed away. They applied for jobs posted by the captains of *Bedelia* and *City of New Beijing*. Maybe, someday, you'll have that chance."

Not likely, Bobby thought, knowing Mr. Ladysmith's opinion of his scholarship. He hadn't even been chosen to recite a dumb old poem. And even if so, the remote possibility could not compensate for his lost, last tomorrow. He mumbled as much.

"I know," Uncle Mord agreed soberly. "I felt the same way at your age. I still do." ■

IN TIMES TO COME

● There's been speculation that humankind is presently entering an era when it will have no need for the armies and arsenals various groups have built up to conquer or defend against others. Such a hope may or may not be premature, but suppose it's true: does that create any new problems? If the governments of the world should somehow manage to create a time free of international strife, the fact remains that a sizable amount of human evolution seems to have gone into producing a propensity for conflict. That propensity is not (despite a claim sometimes heard) a *universal* human tendency, but it does belong to some of us. So—if some humans manage to create a worldwide peace, what will they do with those others who consider soldiering their natural calling? Maya Kaathryn Bohnhoff probes the question in next month's lead novella, "Heroes," with a cover by Kelly Freas.

John and Mary Gribbin's fact article, "Where Buffalo Roam. . .," takes a brief but timely look at the impact of climate change on civilization—in the *past*, not the future. Our October issue also offers stories by Ian Stewart and Mary Caraker, plus the conclusion of W. R. Thompson's *Outlaw*.

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The Alternate View

THE RISE AND FALL OF GYRO-GRAVITY

John G. Cramer

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James Blish's famous "cities in flight" series, first published in the *Astoundings* of the 1950s and later collected in *Cities in Flight* (Avon, 1970), used a device called a *spindizzy* (or "Dillon-Waggoner gravitron polarity generator"), a wondrous contraption that used principles from the "Blackett-Dirac equations" to transform rotation and magnetism into gravitational attraction or repulsion, making enough antigravity to lift whole cities and in the bargain providing impenetrable shielding and faster-than-light travel. Both spindizzy and Blackett-Dirac equations were purely the products of Blish's far-ranging imagination, but the work of P.M.S. Blackett is real.

Blackett was a prominent British astronomer who noticed a correlation between the rotation rates, the gravitational fields, and the magnetic fields of the Sun, Earth, and Jupiter. In a paper in the British journal *Nature*, Blackett presented an empirical equation relating these quantities. He went on to suggest that there might be a previously unsuspected principle of nature by which magnetic fields are generated directly in massive electrically neutral rotating bodies like the Earth.

A few years later, a science fact article in John W. Campbell's *Astounding Science Fiction* described Blackett's work as the possible discovery of a new law of nature. The author of that article suggested that if gravity and rotation could produce magnetism, then rotation and magnetism might produce gravity and even antigravity. With some nudging from Campbell, James Blish picked up Blackett's ball and ran with it. Hence, the spindizzy.

In the SF of James Blish the ideas of Blackett lead to the stars, but unfortunately they never got off the ground in the real world of physics and astronomy. Improved measurements of the magnetic fields of various objects in the Solar System did not fit the predictions of Blackett's "law," nor did the geological evidence that the terrestrial magnetic field undergoes periodic reversals. The present "standard" explanation of planetary magnetism is that in the liquid cores of planetary objects are dynamic currents that are coupled like dynamos to the planetary rotation. These currents generate the magnetic fields of the objects.

Over the recent 1989 Christmas holidays, however, it appeared that the spindizzy and gyro-gravity might be due for a renaissance. A paper entitled "Anomalous Weight Reduction on a Gyroscope's Right Rotations about the Vertical Axis on the Earth" appeared in the December 18, 1989 issue of the journal *Physical Review Letters*. It is the work of two Japanese physicists, Hideo Hayasaka and Sakae Takeuchi of the department of radiation engineering, Tohoku University, in Sendai, Japan. The paper presented detailed evidence that three different motor-driven gyro-

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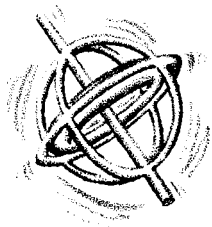

scope rotors made of brass, aluminum, and silicon-steel each showed a weight loss of up to 12 milligrams (weight) or a few parts in 100,000 in overall weight when the gyro was spun clockwise (as viewed from above) at between 3 and 13 thousand RPM. The gyros showed no weight-loss effect when spun counter-clockwise. The clockwise-spin data showed that the weight loss of the gyro depends linearly on the rotation rate of the gyro. The weight loss data is very regular. In fact, it is *too* regular for strict consistency with the error bars of the experimental data points. The Hayasaka-Takeuchi paper was careful to emphasize that no known physical effect, including general relativity, can account for an effect of this size and rotational dependence.

There was a considerable delay before the gyro-gravity paper actually appeared in print. It was first submitted to the rapid publication journal *Physical Review Letters* (PRL) on March 7, 1988, but it required an additional 21 months before it appeared in PRL, a journal which ordinarily published within 4-8 weeks after submission. Reportedly the paper was delayed because the PRL editors and referees were very skeptical of the reported effect but could find nothing wrong with the experimental techniques described. After repeated revision of the paper, some re-refereeing, and much editorial deliberation, the paper was finally published.

As soon as it appeared, science-oriented journalists were quick to realize the anti-gravity implications of gyro-gravity. In late December they conducted an intensive telephonic search for scientists and others who were willing to provide quotable comments on the work. This search was made more difficult because most universities and many government laboratories were closed for holidays. One of the most memorable comments on gyro-gravity reported in the press came from "a noted UFO expert," who said that the result must be correct because it is well known in UFO circles that the engines of flying saucers work by gyro-gravity.

Scientists among the quoted "experts" tended more toward skepticism and caution. Many said that the effect must be reproduced in other laboratories before it could be taken seriously. There were also some feelings that the Japa-

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nese result was likely to be wrong because it had a very peculiar and unphysical spatial dependence—it did not change sign when the gyro's spin direction was reversed but instead went to zero.

At a small number of laboratories, experiments were set up to test whether the Hayasaka-Takeuchi effect could be reproduced. There was less of a "gold rush" atmosphere about these experiments than had been the case with the cold fusion furor of the previous year. Perhaps this is because there was more skepticism that the effect was real. Or perhaps the expensive equipment and manpower investment in cold fusion negative results of last year has made the scientific community more cautious about "table-top" experiments with spectacular results.

In any case, the results from a few follow-up experiments to test the Hayasaka-Takeuchi effect have now began to appear. A group at the University of Colorado in Boulder and the National Institute for Science and Technology (formerly the National Bureau of Standards) has reported in a paper that has just been accepted by *Physical Review Letters*. To within their observed error of ±0.5 milligrams, the Boulder group observed no weight loss of the gyro and no dependence on whether its vertical rotation was clockwise or counterclockwise. They used a brass rotor with a hardened steel shaft rotated at speeds between 1,000 and 9,000 RPM. The rotor turned on jeweled bearings. It had about three times the mass of the rotors used by Hayasaka and Takeuchi and an overall sensitivity to the reported effects that was about 10 times greater. There were, of course, other differences in method. The Boulder experiment had very little magnetic material in the gyro, placed it in a Lucite chamber, spun it up with a jet of compressed nitrogen blown tangenially on a nylon gear, and did not evacuate the chamber. Hayasaka and Takeuchi used an integral electric motor to drive their rotor (which included magnetic material). The gyro rotated on ball bearings and was enclosed in an evacuated steel container. In a related paper that has just appeared in the journal *Nature*, Dr. S. H. Salter, a mechanical engineer at the University of Edinburgh, presents calculations showing that the Hayasaka-Takeuchi observations might be explained by the action of vibrations from the rotating gyro on the ball bearings of the apparatus.

Thus, at present gyro-gravity seems to be in trouble. The effect has not been reproduced with similar apparatus, and the observed effects might plausibly result from vibrations. I would hope, however, that before the laboratory tests are abandoned altogether, someone will try using a rotor which, like the one in the Hayasaka-Takeuchi apparatus, contains significant magnetic material. As we SF readers know, a proper spindizzy requires rotation and *magnetism* to operate properly.

Since this has been a short column, I at last have some space to devote to letters and loose ends. One reader, referring to the column on the Bell Inequalities ("Einstein's Spooks and Bell's Theorem," *Analog* 1/90) writes to complain about the use of the term "spooks." It seems to imply, he says, that some

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supernatural influence is required to deal with the problem of nonlocality in quantum mechanics. He argues that in the EPR experiments the photons have to be in the same polarization state, so no supernatural influences are needed.

I agree that there is nothing supernatural in the EPR experiments, but there is a mystery. The puzzle of the EPR experiments is not that the photons are in the same state, but that they remain in an *indeterminate* state (which is neither circular nor linear polarization, for example) until a state-selecting measurement is made in one arm of the apparatus. The "spook" terminology did not originate with me. The word "spooky" in its German form was used first in this context by Albert Einstein himself. He was referring (with some measure of contempt) to the seemingly supernatural action-at-a-distance influences with which quantum mechanics enforces correlations between separated systems which are part of the same quantum mechanical "state." Quantum mechanics seems to require some faster-than-light or backwards-in-time handshaking, done in such a subtle way that it does not permit communication of information.

Incidentally, the Calcutta Paradox ("Paradoxes and FTL Communication," *Analog*, 9/88) which seemed to permit such FTL communications using beams of neutral kaons has been resolved. There was a flaw in the Calcutta group's calculations in the way the mathematics of the problem was set up. Causality is, for the moment, preserved and FTL communication appears to be impossible, even with kaons.

Another reader writes suggesting that my discussion of the twin paradox in general relativity ("The Twin Paradox Revisited," *Analog*, 3/90) wasn't quite right because a universal gravity field would be detectable in that accelerated observers would see a Doppler shift in their observations of light emitted by various stars before the acceleration began.

Wrong! There is also a gravitational Doppler effect which shifts the frequency of light on its way to the observers so as to precisely remove the effect the reader suggests. Einstein first deduced the effects of gravity on light by considering just this kind of situation. The equivalence principle of general relativity requires that the switching on and off of a universal gravity field must be absolutely undetectable in all ways.

In another column ("Supernova 1987A," *Analog*, 12/87), I referred to seeming anomalies in the supernova's light curve then emerging, and to pulsar-driven models that might explain this unusual behavior. That light curve, as it turns out from more careful measurements, was not all that unusual and could be accounted for with a few tweaks of the standard model. The pulsar expected to be formed by SN-1987A has remained in hiding. One group of astronomers reported that they caught a brief one-day glimpse of it, before it was once again obscured by the plasma from the original explosion. That one-day look was remarkable because, if the data is correct, the pulsar is spinning so fast that it should have exceeded bursting limits calculated for a neutron star. It should have literally flown apart like

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an overspun flywheel. However, that startling observation has now been retracted. It seems that the "high-spin pulsar" signal was actually pickup from a TV camera sometimes used with the aiming apparatus of their telescope. It was on at night during their measurements, and off during the day when they were checking and calibrating their equipment. But while the fast pulsar signal seemed valid, a great flood of theoretical papers were published to "explain" the observations. It is at times like these when we see how much theoretical ideas need good experimental observations to keep them on the right track. That, after all, is the way science works. ■

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S. H. Salter, *Nature*, (February 4, 1990).

●There is little incentive to build a replicator even resembling one that can survive in nature. Consider cars: to work, they require gasoline, oil, brake fluid, and so forth. No mere accident could enable a car to forage in the wild and refuel from tree sap: this would demand engineering genius and hard work. Likewise . . . replicators built in accord with suitable regulations would not even resemble anything that could run wild. The problem—and it is enormous—is one not of accidents, but of abuse.

K. Eric Drexler

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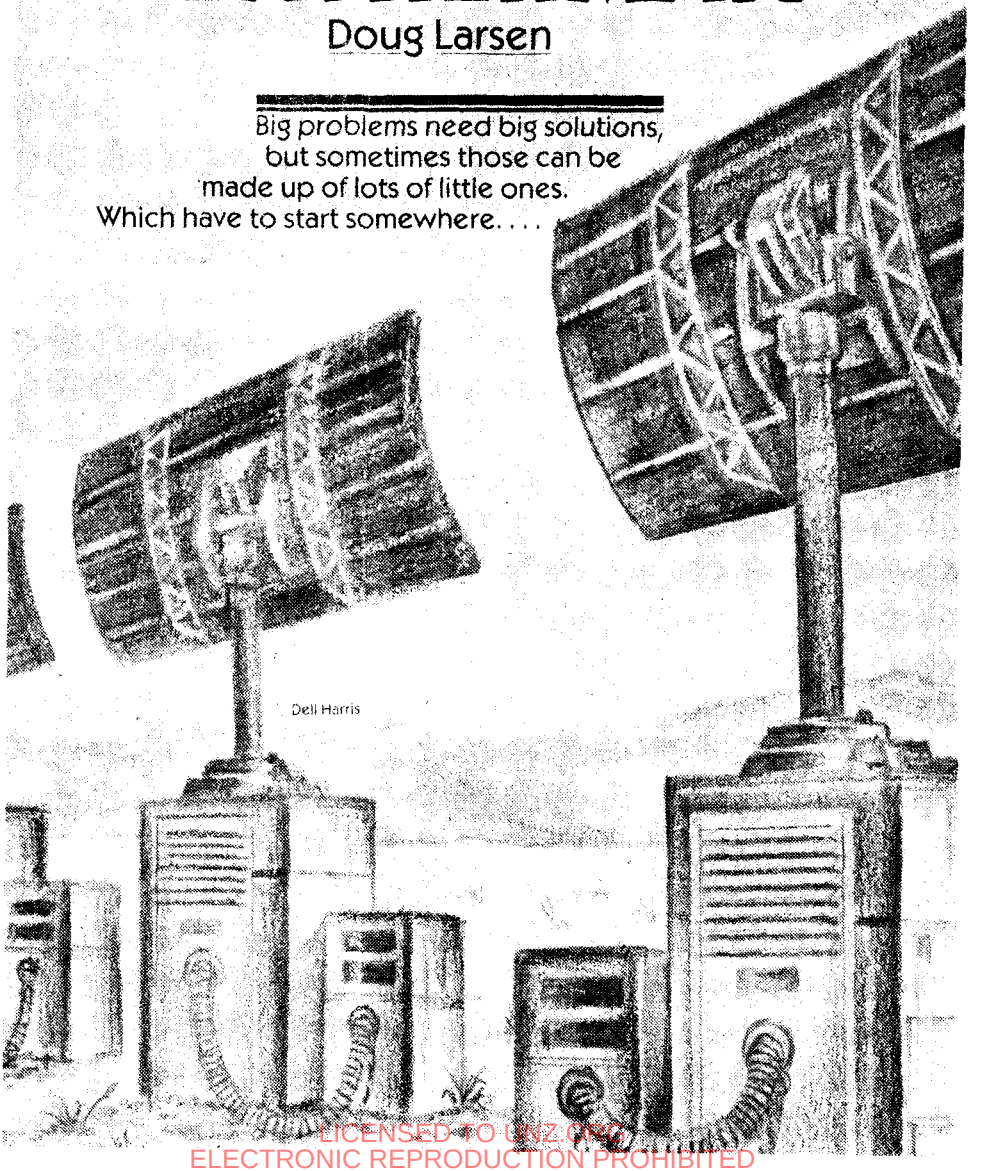
ONLY THE WEATHERMAN

Doug Larsen

Big problems need big solutions,
but sometimes those can be
made up of lots of little ones.
Which have to start somewhere. . . .



Dell Harris

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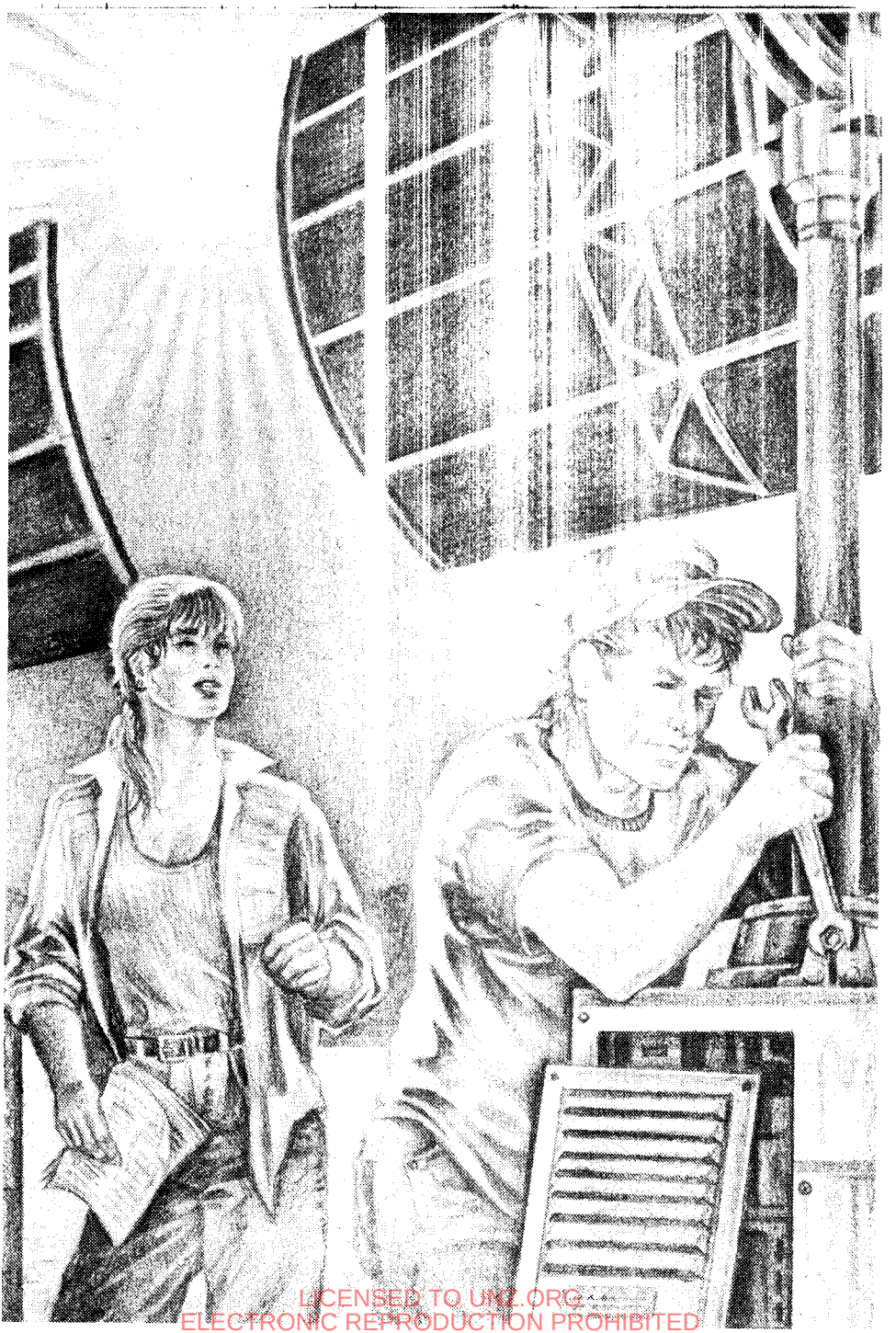

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I love it here.

Maybe because I was born here, and didn't leave until I graduated from high school. There's just something about small towns. The quiet streets, the relaxed atmosphere, the security of knowing almost everyone. Even though I became comfortable with big cities when I went to the largest university in the state, I decided to come back home because I love Harlowton.

Harlowton isn't really that small. It's a county seat, so there is a state patrol headquarters here. We've got a county courthouse, with a municipal judge, and some of the seed companies have their district headquarters here. It used to be a transfer station for the railroads before they went bankrupt.

It hovers around ten thousand people, but that doesn't count the farms and ranches that spread out for hundreds of miles around the town.

"We're glad to have you," my dad said when I moved back in after college. "But why did you come back? You were telling us about all of those great jobs you'd been offered."

Dad was right about the jobs. I'd done well in school. My first degree was in engineering, which I liked so much I got my master's in physics.

"I want to help out, Dad," I told him. "This is home. I want to see what I can do."

A shadow crossed his face. "Only the weatherman can help us now," he said. "But I appreciate your attitude."

Harlowton used to be a farm town, but now it's a drought town. Dad is the city engineer, and Mom is the vice-principal of the elementary school, so we live in town. And I could see the effects of the drought all around. Lawns were stretches of dusty, brown hay. It was so bad that the kids didn't even play on them, which added to the feeling of abandonment. There were fewer kids, because there were fewer people. The latest graduating class had had half as many students as mine did only seven years before. People were leaving in droves. Very depressing.

Some people blamed Harlowton's problems on the greenhouse effect. Others said it was a natural drought cycle. Whatever the cause, the middle of the country was beginning to look like the Dust Bowl of the 1930s.

And Harlowton was dying.

After I'd been home for a while, I read in the local paper that there was going to be a town meeting to discuss the town's future and the drought in general.

"You should go," Mom said. "It'll be a good way for you to get back into the stream of events in town."

A few days later we were assembling at the town hall. The parking lot was full, and the hall was jammed with people. I vaguely recognized almost everybody. Mom knew most of them, and reintroduced me. I was amazed. Everyone looked much older than they should have looked, apparently because they were tired and frustrated. They didn't have much hope.

We found seats and settled back as the mayor called the meeting to order. Then he looked out at the crowd and smiled. "Before we get started, I'd like to welcome two of our young people who have come back from college." He

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looked over to my right. "Jim Newman is back after attending the Land Management Institute at Iowa State University. He has earned his bachelor's of science in farm management, and a master's of science in irrigation techniques. We're glad he's back, and we hope he's got some ideas for us. Jim, why don't you stand?"

A young man stood, with his face kind of red, and people applauded politely. I remembered Jim Newman from high school. Kind of cute, and very shy. The years had been good to him. He looked more solidly built, and more confident. And more handsome. I clapped along with the rest until Jim sat down.

The mayor looked at me and smiled again. "There's another youngster here, coming back to Harlo after college. Joanie Thompson, you may recall, was the head cheerleader seven years ago when our football team went to the state tournament, and was Homecoming Princess. In her senior year, she was voted the girl with the most school spirit. Joanie, why don't you stand?"

I stared at him in disbelief, and then struggled to my feet as people applauded. I tried to smile, but felt my face flaming red.

I grabbed Mom's arm as I sat back down. "I can't believe he did that!" I hissed. "I went to the University's Institute of Technology! I have a master's degree, and a bachelor of science degree, and all he mentions is cheerleading?! That was seven years ago! Why would he tell about Jim Newman's record and not mine?"

Mom patted my arm soothingly. "He doesn't mean anything by it, Joan. That's just how he remembers both of you. Jim Newman was always a quiet, studious boy, and you were the outgoing, popular cheerleader."

"Is that how the whole town thinks?" I asked.

"Probably."

I slumped back in my seat. I had changed a lot in my seven years. I had to admit, I hadn't been back much because summer jobs had been nonexistent in Harlowton. But still—it was humiliating to be thought of as a pom-pom-waving bimbo.

When the meeting finally broke up, I worked my way through the crowd toward Jim Newman. It wasn't easy. There was a horde of people who wanted to talk to me and welcome me back.

I had made it halfway across the room when a hand landed on my shoulder. I turned and looked into the beaming face of a man I recognized from years back.

"Joanie!" he boomed. "Remember me? Arnold Thone, Debbie Thone's father!"

Debbie Thone. Of course—my cheerleading co-captain in my senior year. I remembered him now. A nice, somewhat strict father. His daughter and I had spent many evenings sitting around their dining room table, discussing boys.

"Of course," I said. "How are you? And how's Debbie?"

"You just made a big mistake," he said, smiling broadly, reaching into his back pocket. "You gave me a chance to show you some pictures of my grandkids."

It was interesting seeing pictures of Debbie again. She had two cute little kids, and was still with her husband, the

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captain of the basketball team in our senior year.

"They live in Minneapolis now," he said regretfully. "No jobs around here. Well, I should shove off. I'll probably be seeing you again. I'm on the city council, now. I'll tell Debbie you said hi."

He moved off, and more people crowded in to talk to me, all hoping that my school spirit would help raise the spirits of the town. For the first time, I could tell how people saw me in high school: a cute, energetic bubblehead who is fun to have around, but not to be taken seriously.

When I got over to Jim, he was talking seriously with the mayor. The mayor saw me coming up, and gave me a big smile. "So, how's Joanie these days? It's good to have my favorite little girl back!"

I managed to say something pleasant, and the mayor patted me on the shoulder. He looked at Jim. "That project sounds real interesting, Jim," he said. "It could have some good uses around here. Keep me posted." Then he moved away. I was left with smoldering confusion. The mayor obviously liked me. He apparently didn't realize that I wasn't fifteen any more. I decided to deal with that later, and turned to Jim.

"Hi, Jim," I said. "How have you been?"

"Er—Joanie Thompson. Hi," he said, obviously ill at ease.

"Please," I said. "Call me Joan. I haven't been Joanie since high school."

He looked a little surprised, but just nodded. He started to turn away.

"Tell me about your project," I said.

"It's pretty boring," he said. "You wouldn't be interested."

"If it helps Harlo, I'm very interested," I said, getting irritated.

"All right. It's an experiment in alternative irrigation techniques." He looked annoyed and defensive. "It could help out the farming community. But it's not glamorous, and there's nothing in it to cheer about." He walked away abruptly, and I stood there speechless.

My parents had already left, so I trudged home wearily. Even that late at night, it was oppressively hot, which didn't help my mood at all. I went to my room and pulled out my high school yearbook. I read the blurb beside my name.

"Joan Vanessa Thompson. Joanie. Jo-Jo. Bubbles. Senior Varsity Cheerleading Captain. Homecoming Princess. The Crowd. Memorable football parties. Plans include college."

I shook my head and stared at my picture. "Bubbles," for God's sake! I couldn't believe that girl had been me. "The Crowd." I had actually forgotten about that. We were the "in" crowd, and we had known it. As I looked back, I had to admit that we had been pretty snotty.

Yeech.

I shoved the yearbook under my bed. No wonder Jim had acted that way. I had been a brat, and he remembered it even if I hadn't. I wondered what spiteful things I said to him in high school that still burned. I had no idea. But I decided I had to fix it.

I screwed up my courage and called him. I told him that I was now a physicist and not a cheerleader, and asked

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if I could help on his irrigation project. He seemed very surprised, and was actually pleasant. He said that it was hard, hot, grimy work, but if I didn't mind, I could show up at his house first thing in the morning.

I felt much better. I grabbed a drink of water, and went to bed.

I was nervous the next morning as I drove west toward the farm where Jim was living with his parents. Jim was standing on the edge of one of the fields as I drove up his driveway. He glanced at the car, and then kept scanning over the tops of the corn. I got out of the car, and a blast of heat struck me in the face.

I picked up my thermos jug filled with water and walked slowly toward him, feeling my clothes already starting to stick to my body. The humidity must have been 80 or 90 percent, and I could already feel it draining my energy.

Jim looked a little surprised as I approached. I was not at all like he remembered. My hair was back in a simple ponytail, I was wearing an Institute of Technology T-shirt, a pair of blue sweatpants, and some soiled sneakers. Work clothes. Not teenybopper clothes.

He was wearing an old baseball cap, T-shirt, blue jeans with several holes in them, and work shoes. He showed an unpretentious dignity as he stood there. His face was in shadow under his cap, but he still squinted as he looked at me. "Hi, Joan," he said, as if the name was new to him.

"Hi, Jim. Thanks for letting me come and help out."

He laughed uneasily. "Most people wouldn't want any part of a project like this."

"Well, I'm probably only here because I don't know much about it," I joked. "What's the story?"

He smiled. It was a nice smile. "Basically," he said, "it's a spin-off of irrigation techniques I studied in Israel. I spent a semester on a kibbutz in the desert, seeing how they turned a desert into farmland with the limited water they have."

"Sounds pretty applicable to me."

"It really is." He seemed excited. "We throw the water through the air indiscriminately, simulating rainfall. It's convenient, but inefficient. We water bare ground, weeds, and the crop. On a day like today, only less humid, you lose thirty or forty percent to evaporation. But the Israelis do it differently. They run pipes through the field. These pipes have holes in them at the base of each plant. So the water runs straight onto the plant, and not a weed. There is almost no evaporation because it travels no distance through the air."

I nodded. "That makes a lot of sense. How much water will this save?"

"Probably 50, 60 percent."

I was impressed. "Wow."

"Just out of curiosity, why are you helping me?"

"It seems worthwhile." I felt a little uncomfortable. "I want to help the town. So do you. The difference is, you have a project that will help. I don't. I'd like to help you with yours until I come up with one of my own."

Jim nodded slowly. "You're not at all like I remember you," he said.

"I take that as a compliment," I said,

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hoping my face didn't color. "Thank you."

"You were the most popular girl in school. Why'd you change so much?"

"Everybody changes in seven years," I said, "especially as they grow out of adolescence. I earned a B.S. and an M.S. I'm different now."

"I never thought of it that way," he admitted.

"Nobody in Harlo has," I answered. "For some reason, an excruciatingly shy, bookish boy can grow up to be a self-assured, intelligent man, but a teenybopper cheerleader can't grow up to be a thoughtful, intelligent woman."

"How excruciatingly shy was I?" he asked.

"Very," I said. "I tried to talk to you a few times, but you didn't talk to me."

"I didn't know what to say. So I didn't say anything."

"I didn't know what to say either. So I said a lot."

He nodded his understanding. "I'm glad you told me. I thought I was a lot more secure than I was in high school, but when I suddenly saw Joanie Thompson, I immediately thought that you were a stuck-up cheerleader coming to insult me. And I panicked, just like I would have in high school."

"High school is not a time I like to remember," I said. "Why don't you tell me what we're going to be doing?"

He smiled and pulled out a blueprint.

The work was hellishly hot, frustrating and tedious. Jim's mom brought out fresh water continuously, and kept telling us not to overexert ourselves.

I left around four because I was going with my parents to my aunt and uncle's house for dinner. "You don't have to come tomorrow," Jim said.

"Why not?"

"Well, this is tough work. And it's not even your project. You're entitled to take a break."

"I've had a three-week break," I answered. "And you'll wear out before I do." I was lying, and he chuckled because he could tell.

My Aunt Marlene and Uncle Jerry were a couple of my favorite people. I had spent half my childhood on their farm, and I was glad to see them again. After dinner, Uncle Jerry gave us a tour of the farm. As we strolled out toward the barn I noticed something off on its south side. "What's a solar collector doing here?" I asked, leading them in that direction.

"Well, I've had it since before you were born," Uncle Jerry said. "I stored it under a tarp behind the barn until about four years ago, when I got it working again."

"How did you happen to own one in the first place?" I asked.

"Years ago, Harlo was part of a Federal Solar Test Area," Uncle Jerry explained. "Just about everybody on a farm got one. We figured it was just another federal boondoggle, but we used them for a while. Then interest in solar dried up, and nobody knew what to do with them, so we stored them away."

"How well does it work?" I asked.

"Not too bad," he said. "It's taken a chunk out of our utility bills."

I looked over the apparatus. It had a parabolic trough-shaped collector, not the dish-shaped one that I usually pic-

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tured on solar collectors. It was fairly simple—it would have to be, considering how old it was. It looked antiquated, considering the photovoltaic cells the Japanese were marketing, but if it helped, why not? I examined the system. "What do you run through here as a heat collecting agent?" I asked.

"Not sure what it is," Uncle Jerry said. "All I know is that it smells bad when it gets hot."

"I think the instructions are in the shed," Aunt Marlene said. "I'll see if I can dig them up." I looked over the unit as she bustled off.

"What are you looking for?" Dad asked.

"I don't know," I said. "It's just an interesting device. Seems to me we could use it, somehow."

"We are," Uncle Jerry pointed out.

"I know," I said. "But even more."

Aunt Marlene came up with some grimy papers. "Your uncle used them to mop up some oil he spilled, so they're in worse shape than if I had stored them. But I think they're legible."

I grinned at Uncle Jerry, and looked over the papers. "It's a heat-conducting oil," I said. "Serves as a heat transfer agent."

"Oh," said Uncle Jerry.

"You ever think of running something over the heated pipe?" I asked.

"Why?" Aunt Marlene asked.

"You could cover this section with a transparent pipe, and pump sewage through it," I said.

"Why sewage?" Mom asked distastefully.

"Because this collector concentrates the Sun's UV radiation," I explained. "It would speed up the sewage's decomposition. You end up with the two basic components, separated and partially purified: water and methane."

"Water?" they all said quickly.

"Methane?" Dad added as an afterthought.

"Yep," I decided, straightening up. "I don't see why not."

"I wouldn't want to drink sewage water," Mom said.

"I wouldn't either. But you could use it for irrigation. It'd be clean enough for that."

"Can I see those instructions?" Dad asked in his best engineer's voice. I handed them to him, and he began poring over them, Uncle Jerry looking over his shoulder.

"You'd have to adapt the system quite a bit," Dad said slowly.

"True," I said. "But it's mostly piping. It's nothing a good plumber or engineer couldn't handle."

"For heaven's sake, use your imagination," Aunt Marlene said. "Take the idea, and find an application. Like Harlo's main sewage system. If only we knew the city engineer, we could talk him into looking into the possibilities." She looked pointedly at Dad.

"Erm, um, yes, right." Dad said. He looked at the instructions again. "Can I take these home?"

I don't remember much about the rest of the evening. I didn't even watch the weatherman on the evening news. I told Jim about my idea the next day, and I was excited to find out what he thought of it.

"That's a very creative approach to existing technology," he said. "It doesn't

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do us any good to have it if we can't figure out how to use it."

"That was my problem in college," I said. "I'd be reading a textbook, and something I read would spark an idea. My mind would go off on some tangent, exploring the idea, and I'd have to pull myself back to what I was studying."

"That's creativity," Jim said.

I smiled modestly. "My dad is looking into the city sewer system now," I said. "We'll see if it comes to anything."

He chuckled. "Who'd have thought that a clunky piece of machinery like a solar collector could have a new use like that?" he mused. "You know, we have one here, someplace."

"Really?"

"Sure. Back in the old barn. Want to see if we can find it?"

I was ready for a break. "Let's."

The old barn was behind the new barn, and ready to fall down. But we found the unit easily. It loomed in a corner, covered with tarps, a roll of chicken wire, and a bunch of trash. We created a lot of racket clearing the thing off.

"This is different from my aunt and uncle's," I said, looking at it, "but it's still a parabolic trough reflector."

"The government was probably conducting some kind of comparison," Jim observed. "I'll bet all of the units in Harlo have the trough instead of a dish. And somewhere there's a town with a bunch of dish-shaped collectors collecting dust."

"Well, the concept is still the same." I started explaining my idea, pointing at things with a flashlight beam in the dim barn.

Jim bent over and looked at the collector. "What's this?"

I looked. "That's just the flexible connector for the piping. The sewage could be pumped through a transport pipe put over the heat-conducting pipe, and after it's decomposed, piped off somewhere else."

"It seems strange that you could pump anything you felt like through here," Jim mused. "Who would have thought of using it for something other than hot water?"

"You can do anything you want with these," I said. "I did some historical research on them for a paper in grad school. The sewage idea had just incubated in my mind for a while."

"It looks like you could run the piping anywhere you wanted, too," Jim observed.

"Probably," I agreed. "My paper wasn't on solar collectors specifically, so I didn't get into them a whole lot. These devices could probably be used for more than just sewage treatment."

Jim said, "Instead of getting back to work right away, why don't we try to find the instruction manual for this thing?"

The thought of the heat and humidity outside made me agreeable to anything that would keep us in the barn for a while. "Sure."

We rooted congenially through the barn. We were already filthy, so more grime didn't matter to us. It took quite a while, but Jim eventually fished out a wilted sheaf of papers. Some of the sheets were torn, but all of the pieces were still attached. I leafed through it, Jim looking over my shoulder.

"It's pretty technical in spots," I ob-

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served. "Can I take this home to compare to my Uncle Jerry's?"

"Well, as you can see, we use it a lot around here," Jim joked. "We'd need it back in about five years or so."

We could only work five hours a day or so, and that was if we started early. The heat just killed you after a while. That night, I was drinking water and lounging on a couch in my parents' living room, trying not to listen to the weather report. My parents never missed it, and I couldn't figure out why, because it was about as pleasant as pulling teeth. But like Dad said, only the weatherman could save us now, so they kept watching and hoping.

I had asked Dad about the city sewage system, and he said that he hadn't had a chance to look into it yet. But I was beginning to have doubts. Harlowton had no problem with sewage disposal. There probably wouldn't be enough methane to make the project cost effective in existing buildings. If someone was installing a new septic system or building an apartment complex, it would be worth looking into, but there wasn't any building going on near Harlowton.

It was a good idea, I decided, but not one that would work here.

The weatherman was droning on about a stalled high pressure system, so I decided to look over Jim's instruction book. It seemed less complete than Uncle Jerry's and was made by a different company. Some of the diagrams showed they were basically identical units. Uncle Jerry's was a more professional job, so I leafed through it to get a handle on the capabilities of the units.

One section was intriguing. It warned that if you kept pumping the fluid through the collector when there wasn't any sun to heat it up, the unit would radiate the fluid's heat at a rate proportional to the fourth power of the temperature of the fluid, resulting in an energy drain. I got another glass of water as I mused over it. I hadn't thought of that, but it made sense. I didn't see anything in it for me, but hours later I woke up sitting up in my bed.

I groped for my alarm clock and looked: three in the morning. But I was wide awake.

Why? It hadn't been a noise in the house. I put on my bathrobe, tiptoed out to the living room, and pulled a chair up to a bookcase full of my college textbooks. then I started pulling books off the shelf and leafing through them furiously.

In the morning, when Jim came out of his house, he found me waiting for him.

"How long have you been here?" he asked, startled.

"About an hour," I said. "Let's go."

I led him toward the field. There was a low stone fence in the shade close to the field where we had gotten in the habit of sitting and chatting when we took breaks. "What's going on?" Jim called after me.

"I'll let you know in a minute," I said. "Hurry up."

He caught up quickly. I hopped up onto the wall and Jim sat facing me. He looked closely at my face as he unscrewed a Thermos of coffee.

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"You're acting strange this morning," he commented.

"It's because I'm excited. Now, listen. I have a big idea."

"Tell, tell," he exclaimed, hitching forward.

"OK, first tell me about the greenhouse effect."

"Everybody knows about the greenhouse effect," he said. "We've been hit with it on TV for years. It's popular with the general media, but I'm not sure about it, myself."

"That doesn't matter," I said. "Just bear with me while I walk you through my thought process."

"OK. The greenhouse effect says that there's too much carbon dioxide in the atmosphere, mostly because of pollution. The carbon dioxide is holding warmth in the Earth's atmosphere, which is melting the polar ice caps, and making hotter summers. It may be responsible for keeping the jet stream up in Canada, which keeps the rain away from us."

"But why is the carbon dioxide making us warmer?" I asked.

"Because it's absorbing heat that the Earth would otherwise radiate out into space," he said. "It's always happened—if the Earth couldn't keep some heat, it would be a frozen, barren planet. But the argument is that now it's happening too much."

"Right," I agreed. "The Sun radiates heat to Earth in short wavelengths because it's hot. Then the Earth tries to radiate it back out, but once it's entered the environment, it's cooler, and therefore travels at longer wavelengths. And most of the wavelengths happen to be wavelengths that are highly absorbed by carbon dioxide and the other greenhouse gases."

He nodded, still wondering where this was going.

I continued, "But you see, the only reason the greenhouse effect happens is because the greenhouse gases absorb in the same wavelengths as a lot of the heat the Earth tries to radiate out. They're like a blanket over the Earth, with only few holes of any size. The biggest hole, where there's no absorption, is between eight and twelve and a half microns."

"How do you know?"

"I looked it up. But whoever figured it out took the gases in the atmosphere and plotted the wavelengths they absorbed at. Carbon dioxide absorbs from fourteen to sixteen microns, and also from four to four and a quarter. Freons and nitrogen dioxide absorb from twelve and a half to fourteen, methane from about three to three and a quarter. Nitrogen dioxide also absorbs a few other wavelengths around five and six microns, and also just below eight. There are a bunch of other gases: Nitromethane, nitric oxide, water vapor, sulfur dioxide, and so on. When you're done, you've got the blanket over the Earth. The blanket has a lot of little holes where there are no absorbing gases, but the only really big one is from eight to twelve and a half microns."

This was obviously more detail than Jim wanted, but he nodded politely. "So?"

I smiled at him triumphantly. "In your barn, you've got a unit that will radiate heat out into space at wavelengths that will include eight to twelve and a half microns!"

He looked at me with comprehension

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slowly flooding his face. "Ohhhhhhhhh," he breathed. "Oh, wow!"

"That's what I said about 4:30," I said. "We can use the parabolic reflector as the vehicle to send heat out of the Earth environment, just like the Earth does."

"How do you make it do this?"

"Here's the idea. We take the parabolic collectors. As you know, they're configured to concentrate all of their collected energy on a pipe that runs along its axis."

"OK," Jim prodded, nodding.

"The heat collecting fluid runs through the pipe, and is heated up by the energy of the Sun, which is concentrated by the parabolic dish," I said. "That's how you use solar collectors as hot water heaters."

"I know this stuff," Jim prodded.

"OK, but did you know that you can unfocus the parabolic dish so it doesn't concentrate all of the reflected energy onto that pipe?"

"No, I didn't," Jim said. "But why would you want to? Wouldn't that defeat the purpose of the collector? Why have that pipe running through it then?"

"Forget the pipe for a minute. If you unfocus the collector by enlarging its diameter, the Sun's energy will converge on a point pretty far above the pipe. But since it's not focused on the pipe, it'll just keep on going—out into space."

Jim thought for a minute. "So you're talking about a rejection of any solar gain in the area taken up by the collector."

"That's right," I said.

"But you're talking about a minuscule area that's rejecting solar gain," Jim said. "One collector's area is tiny, when you consider the massive system we're trying to influence."

"We'll need a lot more than one collector."

"But say you get a lot of them," Jim said, and I could tell he was trying to be nice about his skepticism. "You're still not pumping heat out of the system. You're just rejecting additional heat. Which is good, because the surrounding area isn't able to reject it, but since it's over such a small area, it won't make much difference."

"I'm not done yet," I said. "Now comes the most important part. Remember the pipe running through the focus of the collector."

"What about it?"

"That pipe will make it possible to do what you just mentioned," I said. "It will pump heat out of the environment around us."

"How?"

"We'll rig heat pumps to our solar collectors," I said. "The heat pumps will draw heat out of the environment, and transfer it to the heat conducting oil that runs through the pipe. That will heat up the pipe, and cause it to radiate the heat out to the parabolic collector."

"Which is unfocused?"

"I'd call it refocused," I said. "The heat will radiate from the pipe, reflect off the refocused dish, and the dish will beam it off into space, too."

"So you're taking heat from the environment, and pumping it out into space," Jim summarized.

"Right," I said. "Now, tell me what's wrong with it."

He looked at me in admiration, which

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was a very nice look. Then he gazed over the cornfield and thought. "Well, there's the problem of cost," he said. "Those clunkers are rare and expensive. It would take the country a long time to get a bunch of them together."

"I'm not talking about the country," I said. "I'm talking about the equivalent of your irrigation project. See how it does here in Harlo. Then, if it works, we publicize it and we have proof."

"Proof?" he echoed doubtfully. "How do you measure something like that?"

"Ah!" I said. "What happens when you've got a large area that's full of heat, and you pump some of the heat out of the middle?"

He shook his head. He wasn't following me.

"You create a low pressure system," I explained. "You also create a front. Which draws in moist air and creates rain."

He shook his head again because he couldn't believe what he was hearing. He stared intently at me. "You mean . . . let me get this straight. You're saying that our proof will be that we *break the drought?!*"

"Exactly."

He laughed a little crazily. "We break the drought! We break the drought! I'm sorry, but this is a lot to digest so early in the morning. You pump the heat out of the middle of a bunch of hot air, and you create a low pressure system and a front. Colder air against hot, moist air. Sure. That works."

"It doesn't even matter what your opinion is of the argument about the greenhouse effect," I explained. "If it is true, we could counteract it on a national scale. But if it isn't, we can still create a front."

"Which produces rain," Jim said. "But where do you get the moisture?"

"Over there." I pointed west.

Jim looked. "Where?"

"The horizon."

He looked at the mountains on the horizon and shook his head in confusion.

"The prevailing winds come from the Pacific Ocean, sending plenty of moisture inland," I said. "The mountains force it to rise and make the moisture fall on the western slope of the mountains. The people on the western slope never have a moisture shortage. When enough dry air passes over the ocean and picks up moisture, the winds carry some of it over the mountains and drops it on the country to the east. That's us. Our low pressure area will suck more of that moisture over the mountains and make it drop here."

He laughed again. "Oh, wow. Oh, wow." He looked at me. "Why aren't you having any trouble with this?"

"I'm about three hours ahead of you on the adjustment timetable," I said. "You still haven't told me what's wrong with it."

"It's so immense that nobody will believe it."

"We'll have proof."

"We break the drought," Jim repeated, almost religiously. "You pump out the heat, which creates . . . wait a minute. How much heat would you have to pump out to make any kind of a difference?"

"A lot."

"Well, you wanted holes," Jim said, trying to be diplomatic. "Two collec-

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tors wouldn't be nearly enough, would they?''

''No.''

Jim looked deflated. ''I've found out what's wrong with it.''

''No, you haven't,'' I said. ''My dad thinks there were over three hundred solar collectors sent here when Harlo was a federal solar test site. Probably more.''

''Would that be enough to do anything? Could that affect the weather?''

''I think it would, if we got enough collectors doing it,'' I said.

''So there's a problem,'' Jim said. ''Finding enough units. Where do we get the heat pumps to team up with them?''

''We'd have to buy them or have them donated.''

''They're expensive, aren't they? Especially in the numbers we're talking about?''

''We're talking about a nice sum of money,'' I admitted.

''Where do we get it?''

''Well, since we're trying to help Harlo, I guess we'd ask Harlo for the money.''

He kept thinking. ''I still can't get over the idea that it's not enough to change the weather.''

''Well, keep in mind that we're not reconfiguring weather patterns,'' I said. ''Even though we're in the middle of a terrible drought, we have had some rain this summer.''

''Pitifully little,'' Jim pointed out.

''True, but rain nonetheless. It came to us the same way rain comes to us during the wet seasons: from the west, over the mountains. The rain comes naturally to us from there—it's just that the air currents aren't strong enough this year to get it here. So we give it a nudge. That's all.''

''That's all?'' he echoed doubtfully.

''Yeah,'' I said. ''See, even if these collectors and heat pumps seem like a small arrangement, you have to understand that they'll be working at a much higher intensity than the Earth is. If we manage to get our heat-conducting oil up to 600 degrees Kelvin—a little hotter than an average oven—then the radiation intensity of our system will be about sixteen times higher than the Earth's best effort. If we get it even hotter, the intensity increases rapidly. If we got it to a thousand degrees Kelvin, it would be hundreds of times more intense.''

''That is a lot,'' Jim admitted. ''But you don't honestly think we'll get a thousand degrees K out of these things, do you?''

''No,'' I said. ''I was just illustrating a point. Six hundred degrees will do fine.'' After a pause, I said, ''I guess my next question is, what's the next step? How do I get the collectors I need? And the money?''

''Put an ad in the paper,'' Jim joked. ''Better yet, make an appointment to see the mayor.''

I looked at him and smiled. ''Good idea. I'll drop in on his office today after we finish here.''

''I'll go with you,'' Jim said. ''This is exciting.''

We didn't get to the mayor's office until late afternoon, and the mayor only gave us a couple of minutes. ''It sounds like you're asking for city money,'' he said.

''We are,'' I told him.

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"Then it's a matter for the city council," he said. "I'll put you on the agenda for the next meeting, if you want."

"Yes, please," I said politely.

Jim and I walked slowly out into the eye-scorching heat.

"A presentation to the city council," Jim mused. "Big time in little Harlo."

I smiled. I was feeling good, in spite of the heat. "This is pretty exciting," I said.

"Listen," Jim said. "Instead of driving you home, why don't I buy you an ice cream cone first? The diner's just around the corner."

I smiled up at him. "My mom's been wondering when you were going to ask me for a date."

"So I'm asking," he said, blushing a little. "What do you think?"

"It sounds very nice."

"What would you like?" he asked as we strolled toward the diner.

"I've always liked vanilla better than the fancy stuff."

"Cheap date," Jim commented approvingly.

We both chuckled as we stepped into the cool sanctuary of the indoors.

Eight days later, it was still hot. Even as the Sun set, it was oppressive. I looked around the city council meeting room. Somehow word had gotten out that someone had an idea for breaking the drought. The place was packed, people filling all the chairs and clogging the aisles. The air-conditioning, already strained by the heat, was overwhelmed.

I looked over the crowd. I was sweating, but inside I was chilled to the bone. These were the people I was trying to convince, and I wasn't sure they were going to believe Joanie Thompson.

Maybe they would believe Jim Newman. He looked very impressive, standing next to me in a business suit. Every once in a while, he wiped the sweat from his face. Everyone in the room, including me, was doing the same. I was dying to take off my own suit coat, but I had put a lot of thought into what I was going to wear that night. I had to look believable. I had to look professional. I had to look completely unlike Joanie Thompson, cheerleader.

Finally, the mayor called the meeting to order. He explained that the agenda had been cleared to hear a presentation from two members of the community who had an extraordinary proposal to present. "I would like to introduce Joan Thompson and Jim Newman."

Taking a deep breath, I walked to a microphone in front of the council benches. Jim hung back, preparing the charts we had drawn up. I didn't know what kind of response I'd expected, but I was surprised at what I got.

I got nothing.

I looked at the sea of faces and realized that they liked me because they remembered what I had been. But now they realized that I was not the same, and I had not established any scientific credibility with them. Their faces were devoid of welcome or hostility; blank of all emotion except curiosity and expectation.

The only sound in the room was my footsteps. I got to the microphone and turned to face the council. My dad was sitting to one side in his usual spot, available to be called upon if necessary.

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I looked at him for encouragement, but he looked too tense.

I cleared my throat.

"Mr. Mayor," I said, and my voice sounded thin and strained. "Council members." I cleared my throat again, my voice sounding stronger. "Citizens of Harlowton." I concentrated on taking slow, deep breaths. "I would like to thank you for the opportunity to present to you an idea that will save the city of Harlowton and the way of life that we love."

I had everyone's attention, at least.

I ran through a condensed version of what Jim and I had discussed on that first morning. I explained the basics of the greenhouse effect, and heard a stirring in the audience. They knew this stuff well.

"I know all of you here are very aware of the greenhouse effect," I said, breaking from my prepared talk. "But bear with me, because it's vital to what comes later."

I ran through the pitch I had given Jim about drawing Pacific moisture east of the Rockies, but in more detail. Jim and I had prepared charts and diagrams, and we went through them smoothly. I wound up with the clincher: "When you take a large area of heat, and pump the heat out of the middle, you create a front. If you create enough of a front, and if moisture is available, you get rain. That is what we hope to accomplish."

There was an excited buzz from the audience. I concluded, "What we can do here in Harlo is demonstrate that this technology works, by producing rain. On a national scale, this technology could dissolve the high pressure area that's strangling us. It could pull the jet stream down into the pattern it took in the good old days when it supplied rain."

There was a hubbub of voices, and the mayor had to work to restore order. Then he looked at me benignly. "As citizens of the United States, you are of course free to pursue any project you like, without needing approval from the city council," he decreed. "What would you like from the city?"

I smiled. "Money," I said simply.

"Money is not easy to come by these days," he said.

Mr. Thone spoke up. "What guarantees do we have that this will work?"

"We are not able to make guarantees," I said carefully. "The theory is sound. The capabilities are there."

"My bank guarantees me a return of 5.5%," Mr. Thone observed.

"Your bank can't stop the drought," I replied calmly. "This is the first opportunity that's ever presented itself."

"What if we don't get enough rain from this system?" the mayor asked.

"If the system is even marginally successful, it will prove our theories," I said. "If we can document that changes in weather have occurred because of it, then it's a viable system even if we only get a drizzle."

"A drizzle won't do the town much good," Thone said.

"On the contrary," I said, wondering why he was being so difficult. "If success can be documented, it will show that a larger scale application would make rain. That would create a demand for the system, complete with the alterations we've made to the solar collectors. We'd have to produce units to sell.

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Harlowton would stand to gain a substantial industry, with all of the jobs that come with it." I paused. "Let me assure all of you that I intend to live in Harlowton. Any business that I produce will stay in Harlowton."

There was scattered applause from the audience.

Another councilman requested permission to speak. I recognized him as an ally of the mayor and an acquaintance of our family. After some mind searching, I remembered that his name was Bowman.

"Won't the people to our west object?" he asked. "Water rights have been fought over for centuries, and this state still has problems with water."

"They won't object because they will get more water than before, not less," I said. "For all practical purposes, the capacity of the Pacific Ocean to make rain is unlimited. The problem is the mountains, and the inability of the air currents to push the moisture over them, that prevents the rain from making it to Harlowton. When this system becomes operational, the rain won't just hit Harlowton, it will also hit everyone to our west. The ocean can supply all kinds of moisture. We're just improving on the delivery system."

"This proposal intrigues me," Bowman said. "But I have to admit that I don't know a lot about the principles being discussed here. Is there someone on our staff who has looked at this?"

The mayor turned to my dad. "Mr. Thompson, as city engineer, do you have an opinion on this proposal?"

Mr. Thone cleared his throat, but before he could speak, Dad said, "Mr. Mayor, I have to disqualify myself from this issue on the grounds that my opinion will not be construed as purely objective."

"I'm afraid that won't do, Mr. Thompson," the mayor said, and I noticed that he was looking more at Thone than at Dad. "Recognizing your relationship to one of the presentors, you can still comment on the scientific facts offered here. Does the theory seem sound?"

When Dad spoke, he didn't look at me. "I have checked into the theory on my own," he said. I gaped at him in astonishment. He looked at me quickly, then looked away. "I did my own research not because I lacked confidence in the presentors, but because I felt it was my job to check on it."

"And your conclusions?" the mayor interjected with some impatience. "Is this thing valid?"

Dad looked down again. "In my opinion, the general theory is sound," he said.

Thone noisily cleared his throat. "No offense, Mr. Thompson, but you will understand why I find your opinion in this matter somewhat questionable."

Dad looked at him in a way that he had never looked at me. His eyes glittered with hostility. "No offense taken, Mr. Thone."

I felt like I was at a tennis match, looking from speaker to speaker. This meeting had gone completely out of my hands, in a direction that I didn't like. It was obvious that Dad and Mr. Thone had crossed swords before. I wondered why he hadn't said anything about it. The science, I realized, was over. Now it was time for the politics.

"This is a large sum of money we're

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talking about," Mr. Thone continued. "I'd like to remind everyone that the economy of our town is very fragile. There are a lot of people who need help from our city government—for example, the local food shelf asked for a grant to restock its shelves in response to unprecedented demand. We can't afford to spend this kind of money on an untried idea. I move we refuse the money, dismiss the subject, and go back to discussing how we can help our town."

"Second," said a councilman whose nameplate identified him as Mr. Burkhardt.

There was a pause before the mayor spoke. "A motion has been made," he announced gravely. "Any discussion?"

A councilwoman who hadn't yet spoken raised her hand, and the mayor recognized her as Mrs. Rutishauser. "This is appalling," she said. "We have had a mass exodus of high school graduates from Harlo for years. Less than 20 percent of each graduating class remains in our town. Now, two bright young people, filled with ideas and energy, choose to return to Harlo, and we just ignore them? Tell me, Joan," she said, looking at me, "what kind of a salary could you have gotten if you had taken a job on one of the coasts instead of coming back here?"

I opened my mouth to answer, but Thone interrupted. "I don't see this as relevant to the motion."

"But it's completely relevant," Rutishauser countered. "You're dismissing an idea without giving any thought to it. Considering the plight of our town, that's irresponsible."

"We have no guarantees that this system will work!" Thone protested. "We don't have much money in this town! Don't you think we should be sure of what we're spending it on?"

"Have you, for a moment, considered how much it would help the town if this idea worked?" Rutishauser asked, while I silently cheered her on.

Thone shook his head impatiently. "If it's so easy to change the weather using devices that are decades old, why hasn't anyone come up with it before now? Think about it—we're talking about changing the weather! A few backyard solar collectors aren't going to have any influence on a system that massive!"

"We at least owe them the chance to prove that it will work," Rutishauser said firmly. "I move that we authorize our technical staff to further research this idea, and give our two presentors the chance to demonstrate that their equipment will work."

"Mr. Mayor, I want to point out that my motion is under discussion," Thone said. "No other motions can be made until mine is acted upon."

The mayor slowly regained control of the room. "A motion has been made," he said. "We will act on the original motion, and will consider the second motion if the first is defeated."

I stood close to Jim with my heart in my mouth while each council member was called to give their vote. "Oh God, oh God, oh please God," I kept saying over and over. "Oh please oh please oh please." I stared at Mr. Thone. I couldn't understand why he wasn't even giving me a chance.

The four council members split evenly, Thone and Burckhardt in favor of dismissal, and Rutishauser and Bowman

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against. We all swung our eyes to the mayor for the tiebreaker.

"I vote against dismissal," he finally said, and the room erupted in sounds of both praise and recrimination. I discovered that Jim was squeezing my hand in silent celebration. I realized that I was squeezing his, too.

The mayor was pounding a hole in his desk with his gavel. "Order! I will have order in this meeting!" He was yelling, but it took a long time before everyone quieted down.

"We will now act on Mrs. Rutishauser's motion," he said. "Is there a second?"

"Second!" Bowman proclaimed. And to no one's surprise, the vote was identical, with the mayor breaking the tie in our favor.

Once again, the room erupted in sound. The mayor gave us a shaky smile of approval, and the meeting broke up soon afterward.

A sizable group of people left immediately. Jim and I were surrounded by people wanting to know if we really thought the system would work, how much rain did we think we could produce, were Jim and I dating, did I remember the pep fest when we were seniors and boy had I ever changed, and several offered volunteer labor.

"I don't quite follow your idea," one man admitted as Jim wrote down his name and phone number, "but I'm willing to give just about anything a try these days."

Jim walked me home afterwards, and we strolled along, immersed in shaky triumph. Jim shook his head and laughed. "I'm going to be on an adrenaline high for the next two weeks," he said. "That was rough."

"That was rough," I agreed. "Thank God for Mrs. Rutishauser!"

"That's an understatement," Jim said.

"What in the world is with Mr. Thone? I thought he liked me. I thought he'd be interested in hearing about this!"

"Some people have no vision of potential benefits," Jim said. "The space program has always had that kind of problem. You know, the old 'how can you even think of going to Mars when there are people starving?' routine. He is just a variation on that."

"Well, I know the town's economy is fragile," I said, trying to justify Thone's reaction. "But doesn't he realize that this could save it?"

"I think his problem is that you said that this 'could' save it, instead of 'will definitely' save it."

I nodded, deep in thought.

"You handled it well tonight," Jim said. "You made quite an impression on the town."

"But we have to make it rain if it's going to be a positive impression," I said as we got to my house. I considered kissing him, lost my nerve, and just squeezed his arm before I went inside.

My parents looked at me as I passed through the living room.

"Congratulations," my dad said. "Your proposal is still alive."

"Thanks," I said.

"I had to check on it," he said. "It's my job."

"I know," I said. "I understand."

A week later, Jim and I were gathered

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around a completed solar collector/heat pump unit. He was holding a spectrometer borrowed from the physics department of the state university. Jim and I needed it to prove our point. Everyone knew that a solar collector would collect solar energy. We also needed to prove that it would send the heat pump energy out through the atmosphere.

Harlowton had not been a quiet town since the city council meeting. The *Harlowton Times* had carried the story of my idea on its first page, and had a big picture of me and Jim standing at the microphone. Mr. Thone had written an editorial in the same edition, denouncing the council's preliminary approval of our project. He was elaborately polite to me in his letter, implying that my "imaginative" idea was a result of the school and town spirit that I had always demonstrated, and while I was well meaning, I was not to be taken seriously.

It made me wonder. Had he changed so much? Had I changed so much? Or had I ever really known him?

All in all, the *Times* had given us thorough coverage, considering that the paper had probably been past deadline when the news events happened. It just went to show how momentous our proposal was, if the editor was willing to tear his edition apart and redo it.

It also went to show how much leverage Councilman Thone had with the editor if he could get in a long editorial letter at that late date.

I wasn't totally at ease when I was puttering around the collector. It looked like opposition was being organized against our plan, and it wasn't pleasant.

Jim turned on the spectrometer and hoisted its receiver up twenty feet above the dish.

"Great!" I exclaimed, and leaped over to the spectrometer to see the readings. They would be all over the board, of course—from near zero to probably around twenty microns—which would reinforce the fact that the eight to twelve and a half micron range would be well represented.

Jim and I eagerly jostled each other to see the panel's readout. We stared at it for a moment, and began to look puzzled. Jim reached forward and changed the reading scale. No change in the readout.

"That's funny," I said.

"Are you sure this thing works?" Jim asked.

"Sure, I'm sure."

There was a pause as we stared at the stupid thing, trying to get it to give us a good reading by sheer force of will. Finally, Jim spoke.

"It doesn't register any wavelength above about two and a half microns," he said in confusion.

"Maybe it's not pointed right," I suggested hopefully.

He just looked at me. We both knew that that was only wishful thinking.

"Maybe if we moved the receiver around above the dish," Jim ventured, "we'll pick up the right readings."

"Maybe the radiation is missing our receiver," I agreed lamely.

We fiddled with the thing for fifteen minutes. It kept reading a bit above two and a half microns—maybe two point seven or two point eight. I kicked the collector in frustration.

"It's not reflecting the stored energy!" I yelled. "The stored heat is sup-

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posed to radiate from the pipe, reflect off the refocused dish, and head off into space! Why won't it reflect?!''

''Let's try to figure out why it's not working,'' Jim suggested.

''If it won't dump the stored energy, our system is ruined!'' I said, barely restraining the urge to throw myself on the ground and scream. ''We told the council that it'll beam the stuff out into space! And it's not doing it!''

''Let's try to figure out why it's not working,'' Jim repeated firmly.

''I don't know why it's not working!'' I yelled at him. ''My whole theory was based on these stupid things beaming energy to space in a broad enough band to catch the eight to twelve and a half micron window! And they don't!'' I wanted to kick it again, but my foot was hurting too badly. I was filled with rage and frustration, and was dying to inflict damage on something. ''You know what we did, don't you?'' I asked him, shaking. ''We conned them, that's what we did. We went into a desperate town, did a song and dance, and sold them a scheme that has absolutely no scientific basis in fact! They only voted for it because they trusted us. Nobody ever thought it would work! They just supported us because they know us! We may as well be selling snake oil! We're complete frauds!''

''To prove fraud, you have to prove intent,'' Jim said. ''We're not frauds. We're imbeciles. There's a big difference.'' He kicked the collector savagely.

''We went public with an idea that was pure theory,'' I moaned. ''We didn't even do any experiments to back us up! How irresponsible can you get?''

''I just can't figure out why it doesn't work,'' Jim said. ''We're emitting radiation onto a mirrored surface. It should reflect everything! You sure this spectrometer isn't broken?''

Something he said struck a chord in me, and I looked closely at the surface of the dish. ''It's a mirrored surface, all right,'' I said. ''How do you make a mirrored surface?''

''Ummm . . . glass and silver, right?'' Jim said.

''Yeah. Silver or aluminum.'' I looked at it for a long time. ''Which one's on top?''

''It'd have to be the glass, wouldn't it? I mean, the silver or aluminum layer is really thin, so the glass serves as a protective coating, letting the light pass through it.''

''It's the glass,'' I said. ''*Damn* it!'' I kicked the collector again—this time because I figured I deserved the pain.

''What about the glass?'' Jim asked as I hopped around on one foot, making strangled noises. He grabbed me to help me keep my balance, and helped me sit down. ''What about the glass?''

''It's absorbing the radiation we want.'' I felt very tired.

''How can that be?'' Jim scoffed. ''It works fine in mirrors. Why not mirrored surfaces?''

''You're talking about visible light,'' I said. I was so emotionally drained that even explaining it to him was exhausting. ''Glass doesn't absorb visible light, but visible light's wavelength is between three-tenths and seven-tenths of a micron. We need it to reflect a broad band that includes our window of eight to twelve and a half microns. Glass

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starts absorbing radiation before it gets that long."

"It starts around two-point-seven microns, I'd guess from the spectrometer's reading," Jim mused.

I wiped my forehead wearily. "Yeah," I said. "Anything longer than that. So since the glass is absorbing all the rest, we're just heating it up, and it's heating up our general environment instead of reflecting it out into space. Our heat pump takes it out of the environment, and the heated glass puts it back."

"Then how does the collector normally heat up the pipe it's focused on, if the glass absorbs that much radiation?"

"The big heat spike these things use is between 0.3 and one micron," I said. "The glass doesn't absorb that." I was shaking all over. I kept picturing the humiliation coming my way, and it made me shudder. I could feel my dad's eyes boring into me. 'Why didn't you think of that sooner?' he'd ask. 'You know that glass absorbs some wavelengths.'

'Well, you didn't think of it either, Dad,' I thought savagely. 'Not that it does me any good now.'

Jim had picked me up that morning, so he had to drive me home. We didn't talk much. We droned along the highway toward town, and every tumbleweed that rolled in front of our car seemed to be mocking us.

"Let's not tell them right away," Jim said suddenly. "Let's wait a couple of days."

"Why?" I asked without much interest.

"We may think of something."

"Like what?"

"I have no idea," he said. "But then, we're both really upset right now. I know I'm not thinking straight. Let's give ourselves a chance to calm down and give it some thought."

I agreed. Not because I thought I'd think of something, but because I wanted to postpone admitting my failure to everyone in Harlowton.

Jim pulled up in front of my house, and we noticed another car there. "I think that's the mayor's car," I said.

"I'll come inside with you," Jim decided, and I looked at him gratefully. We walked up to the house with mounting anxiety. I took a deep breath and opened the door.

"Well, here they are!" Mom said with false gaiety as we walked into the living room. She and my dad were in conference with the mayor about something. They all stood up.

"How is your project going?" the mayor asked without preamble.

"A little slower than we'd like, but OK," Jim lied smoothly. I couldn't talk.

"Slower!" the mayor pounced on the word. "Why slower?"

"Things are just taking a little longer," Jim said.

"I need you to speed it up," the mayor said.

"Why?" Jim asked.

"You can't always hurry science," Dad said. "Some things take time to be done right."

"Well, they've got to find a way," said the mayor. "Thone's wanted the mayor's office for years, and he's finally got an issue he can use."

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"What!" I exclaimed. "What's going on?"

The mayor glared at me. "Your idea has given Councilman Thone the issue he needs. He's got a reputation as a fiscal conservative, and your idea is political dynamite. I broke the tie vote, so Thone is using it against me. He's just filed to contest me for mayor in the primary election, and he's got me boxed in. You have to convince us that your idea will work, and then it's got to work, and it's all got to be fast, or I'm history in this town, and so is your system!"

"But the primaries aren't until early September," Jim protested.

"The campaigning starts now," the mayor snapped. "Any other questions?"

"You're being a little harsh on them," Dad told him.

The mayor whirled to face him. "Stop being so detached about all of this! You're my city engineer! You spoke in favor of the plan at the meeting! If I lose, where do you think you'll be with Thone as mayor? Out of work, that's where!"

I stood speechless as the mayor stamped out. There was a long pause, and I looked at my dad.

"Keep working on it," he said finally. "We're all behind you." He walked out of the room, with my mom trailing behind him, looking worried.

I looked at Jim, and Jim looked at me. His face was gray. I'm sure mine was too. I couldn't believe what was happening.

"Sleep well," Jim said, trying to joke.

I saw him out, and watched as he drove off. I managed to make it to my room before I started crying.

It was 3:30 in the morning, in the middle of the longest, darkest night I had ever spent, that the phone rang. The sound ripped me out of a wretched doze, and I staggered to the kitchen to answer it. I was so groggy that I didn't even wonder who was calling. The phone commanded; I answered.

"He-oo?" I bleated, sagging against the wall.

"Front coat it," a voice said.

"What?" I asked, not too brightly.

"Joan, it's Jim," the voice said.

"Jim," I said. "What time is it?"

"Three thirty in the morning. Sorry to be calling now, but I haven't been able to sleep."

My mom appeared in the kitchen doorway, looking like someone who had also just managed to fall asleep. "It's Jim," I told her. "It's OK. I'll talk quietly."

She shook her head in a mixture of annoyance and humor. "Young love," she commented, and went back to bed.

I loved my mother dearly, but sometimes she just didn't have a clue.

"Joan? You awake?"

I shook my head sharply. "Sorry. I'm here. What are you doing, calling people at 3:30 in the morning?"

"Not 'people.' Just you. 'Person.' The only person who'd talk to me at three in the morning. I said, front-coat the damn thing."

"What damn thing?"

"The collector," he said impatiently. "Listen, and try to wake up. We're screwed because the glass on the collector is absorbing the wavelengths we

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want to reflect. That's because the reflective material is behind the glass."

"Yeah. It's a secondary reflective surface."

"Well, haven't you ever heard of a primary reflective surface?"

"Of course I have," I snapped. "But we don't have one."

"Couldn't we make one? Couldn't we front coat the collector with reflective material?"

"Like what?" I asked.

"Whatever it's back coated with," Jim said, sounding exasperated. "Aluminum or silver."

"I don't have any," I said.

"Somebody's got to! Give me a break, willya? It's the middle of the night after a disaster of a day. I don't have all the answers. I'm just coming up with some possibilities."

"I'm sorry," I said. "I don't mean to be so negative. But even if we had a bunch of aluminum, how would we front coat the reflectors? Don't you need some sophisticated equipment?"

"Naw," Jim said. "If these were dish reflectors, they'd be tough. But they're parabolic troughs. No problem."

"Hmmmmm." I was still unconvinced.

"I know there are a lot of problems with it," he said. "But we'll come up with something. We're not dead yet."

When I got back to bed, I tried to think of it for a while, but I couldn't. I fell asleep right away. For some reason, I felt better.

I managed to sleep until late in the morning, and was eating a belated breakfast when Jim called again.

"I asked my dad if there was any silver or aluminum lying around," Jim told me. "He said there was a story that during World War Two a bunch of aluminum sheeting was being freighted to some airplane factory in California. It was here in a transfer warehouse when the war ended. The government canceled a bunch of weapons contracts, including those planes. So it stayed here. When the train line went bankrupt, they just locked the warehouse. He doesn't know if it's all true, but he remembers that when he was a kid, he and his friends used to talk about stealing it and selling it."

"Your dad was kind of a felon in his youth," I observed. "Maybe the mayor could tell us if it's true or not. And he'll know which warehouse to look in."

Despite the loss of people, Harlowton had managed to keep the town in good shape, and the warehouse area was no exception. The mayor himself went with us to unlock the building on the edge of town. He pointed with a flashlight to a big pile of stuff along one wall.

"There it is," he said. "Technically, I don't have the authority to let you use it, but nobody else does either. So I figured, why let the stuff lay around if it can do some good?"

"Aluminum's expensive," Jim observed. "Why is it still here?"

"When you're talking about the collapse of a multi-million dollar train empire, some aluminum sheeting in Harlo is pretty insignificant," the mayor said. "The government took over the defunct companies, but this stuff is too insignificant for it to bother with. We've just had it locked up, and people either

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didn't know it was here, or were too law-abiding to steal it."

I had been struggling through a bunch of junk and finally got to the sheeting. I opened up a bundle of it and we pried the sheets apart. The top ones had a healthy layer of oxide, but the rest of them were in good condition, with only a little oxide around the edges.

I looked at Jim. "What do you think?"

Jim fingered the stuff. "I think it's OK. It's on the thick side, but we can work with it."

"Is this contraption of yours going to work?" the mayor asked.

"It is now," I told him, beaming in the darkness.

"Now!" he exclaimed. "What do you mean, 'now'?"

I had dreaded having to explain my shortsightedness to him, but I figured now was as good a time as any. I opened my mouth to tell him, but he held up his hand.

"On second thought," he said. "I'm running for reelection. If you're sure this will work—'now,' " he leaned on the word sarcastically, "then I don't want to hear about anything else. I think I should be in the position to be able to deny knowledge of anything bad at this point." He turned to leave.

"We're gonna need a truck and a forklift," I called after him.

"When?" he asked, still walking away.

"Late tomorrow," I guessed.

"They'll be here at six," he called over his shoulder, and then he walked out of the warehouse and was gone.

Getting ready for the city's panel of experts was exhausting. After our experience with the spectrometer, we were taking nothing for granted. Everything had to work perfectly, and we assumed that nothing would work at all until we saw it with our own eyes.

Our demonstration to the panel was nerve-wracking. I knew most of them, but they weren't very friendly. They knew that their report, whatever it said, was going to be used as political football.

"It's not your fault," one of them told us. "But you sure have stirred things up around here."

"It wasn't part of the plan, I promise you," I answered.

They poked and prodded around the system for a day, and grilled us for another whole day, and at the end, were satisfied. "We can't tell you specifically what we'll write in our report," they told us. "But you'll probably like it."

Jim and I ate lunch at the diner the next day to celebrate. It was moderately full as we walked up, and when we went in, everyone inside hushed up and looked at us.

I stopped short, and looked around. Councilman Thone was at one of the tables, several people were with him. We had stumbled onto a strategy meeting of the opposition. Although the experts' report wasn't out yet, I was sure he had gotten an advance look at it.

I nodded to him, and tried to smile, but couldn't. He gave a curt, uncomfortable duck of his head. I spotted an open booth, and hurried into it. Jim joined me, and winked at me as he sat down.

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"Any rain in the forecast?" he asked me loudly, with a grin.

"Shut up," I hissed at him. "You want to start a brawl or something?"

"Nobody brawls in Harlo," he told me in a normal tone of voice.

The diner stayed quiet, and Thone and his people finished their meals in silence. After they paid their bill, Thone reluctantly walked up to us.

"So how are Joanie and Jim?" he asked with uncomfortable heartiness.

"We're fine," I said, trying to sound friendly.

"A little hot," Jim added.

Thone glanced at him, and I kicked him under the table. Thone cleared his throat and looked very uncomfortable.

"Look. Kids," Thone said, "you understand . . . there's nothing—um—personal in this, don't you?"

I didn't completely believe him, but I found myself nodding. I felt extremely awkward.

He nodded abruptly, and said, "Good." He turned, obviously wanting to leave quickly.

I sat there in confusion. Why had I even talked to him? I should have snubbed him. I should have told him off. Why hadn't I?

I guess because I had liked him. But now, no matter how much I tried to rationalize his behavior, I couldn't escape the conviction that I did not like that man any more. Maybe I was new to politics. Maybe nastiness was the norm in a political race. But I didn't like it. And I didn't like people who did it.

I noticed that Jim was smiling gently at me. I smiled back, still confused.

"Shrug it off," Jim advised. "There's nothing you can do about it."

He was right, but it wasn't an easy thing to do.

A waitress came up to us, and we ordered something cheap because we were both almost broke.

I wasn't quite as nervous at the next city council meeting. The room was as hot, the atmosphere as tense, and the crowd as large as it had been the last time. But this time, Jim and I were seated in the front of the audience, ready to be called on if needed. The main presentation was to be made by the city's engineering staff, and they had a folder full of information certifying that the solar collectors could be made to do what we said they would do.

I wondered what Thone had prepared to oppose us, and squirmed in my metal chair as I listened to the engineering staff reciting their findings. Most of the people drifted off as they droned on, but their conclusion was what I wanted: they had found the system to be viable as described.

"Any questions for the panel?" the mayor asked the council when they were done. He looked at Thone.

Everyone looked at Thone, who shook his head, as did the rest of the council.

"Any questions for Miss Thompson or Mr. Newman?" the mayor asked as I tensed up all over. I watched Thone like a hawk, but he shook his head innocently, along with everyone else.

"Does anyone have any other evidence to bring to this issue?" the mayor asked.

Again, four mute shakes of the head, while I stared at Thone in surprise and blazing suspicion.

The mayor called the vote, and it was

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a duplicate of the last one: Rutishauser and Bowman for funding our system, and Thone and Burkhardt against. The mayor broke the tie in our favor.

Again, the room erupted in sound. Everyone was shaking my hand. Jim's mom kissed me on the cheek. I was confused. I was tensed up for a big showdown, and it hadn't come. Thone had done nothing, and I couldn't figure out why. But the crowd was congratulating me so loudly that it was hard to stay suspicious. Especially when I remembered that this was what I had wanted for so long.

It felt good. It really did.

Jim walked me home after the crowd had cleared. I felt victorious and relieved. Jim seemed happy, but a little quiet. I was still charged up, and kept talking.

"I was just waiting for Thone to speak out," I told him. "I thought the mayor and Mrs. Rutishauser seemed really calm about it, though. Maybe he couldn't dispute the engineers. But I thought that he would have spoken against it. I thought that he would have brought in somebody to say that it won't work. I was ready to defend it—I've got all the charts and weather patterns and everything, and I was ready to show them again. I can't figure out why he didn't even say a word."

We were just a few houses away from mine, and in the dusk I saw someone come out of the garage of the house we were in front of. I vaguely recognized him as the owner of the house. He was carrying a sign attached to a wooden stake. I squinted to read it as he hammered it into his lawn.

" 'Thone for Mayor'," Jim read aloud. We stopped and watched the guy as he finished his job. Then he looked right at us, and walked back inside.

"That's why he didn't do anything at the meeting," Jim told me while I stood rooted to the sidewalk, staring at the sign. "That's why Rutishauser and the mayor were calm. They knew he wasn't going to oppose it. Everybody was locked into their positions at this point. He knew nobody could change their vote, so he's taking it to the polls."

"That bastard!" I said. "I hope we make it rain so hard that he drowns!"

I watched the weatherman that night. I wanted to remember what the weather was like before we changed it.

The next several weeks were confusing and exhausting. The *Harlowton Times* did a big write-up on the approval of our idea. "Thone for Mayor" signs sprouted all over town, and the *Times* carried dozens of letters to the editor, claiming that the city council had been conned out of taxpayers' money. Several organizations wrote in, describing the good they could have done for the town if they had been given that much money. Many letters scoffed at the idea that a little town like Harlo could change the weather.

There were some signs of support. Merchants called, offering to donate items if we needed them. People called, offering volunteer labor. Thone had the opposition organized, but it was clear that he didn't speak for everybody. That fact encouraged me as I flung myself headlong into the job ahead.

We ended up with 207 workable collectors. I wanted more, but 207 wasn't bad. We had come up with 220 collec-

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tors in all, but had to cannibalize some of them.

We lined up workers, and came up with quite a team. We had a few dozen people who could be counted on. Some said they could only help out after working hours, but a distressing number of them were available any time. They didn't have jobs any more.

One by one, we picked up the collectors, had them front coated, and trucked them to Jim's farm. Fortunately, a lot of people were willing and able to transport their collectors themselves. We cleaned them up, put them together, and added the heat pumps. As we finished each one, we put it into position and started it going.

Whoever thought that being an inventor was a glamorous job should have seen us then. I looked about as attractive as a squashed toad. Jim's hair stuck out in bunches here and there, he had dirt crusted in the squint lines of his face, and he was streaked with dirt and sweat and blood from scrapes and cuts.

Funny, but I still liked to look at him. I still thought he looked nice. Of course, there was no doubt that he needed a shower, but he still looked nice. He looked like Jim.

I wondered if he thought of me the same way. I hoped he did.

Actually, I was pretty sure he did. When I was with him, I didn't worry about how my hair was or anything. He made me feel comfortable. So I was happy a lot of the time. Even though I staggered home every night and collapsed into bed, and staggered out in the morning, every joint in my body creaking with pain and fatigue.

But there was so much pressure that I didn't really have time to think about why.

One evening Jim and I stood gazing at the double line of solar collectors that were lined up in a roughly northeast direction beside one of the Newmans's farm fields. There was a crowd of people around looking at the odd contraptions and gazing to the west where the mountains stood on the horizon. Jim looked at me, smiling strangely.

"We're not really done, are we?" he asked.

"As far as I can tell, we're done," I said, wiping a dirty streak of sweat off my face. "It's hard to believe, though."

"And what do we do now?" Jim asked, bringing me down to earth. I noticed that everyone was looked at me for the answer. Behind the grime, hope shone from their eyes.

I shrugged. "We wait," I said.

People started to drift away, but they kept turning around to look at the line of gleaming collectors, look at the mountains, and gaze up into the sky. I remembered my manners in time to thank them all before they drove off. Then Jim and I stood and looked up at the sky, and at the line of collectors and heat pumps.

Jim put his arm around me in a rough hug. "It'll work," he said, reading my thoughts.

"I wish we had more of them," I said.

"It'll work," he said again.

I knew he didn't know that any better than I did, but it was comforting.

I'm not a good waiter. I never have been. Dad said I should be a good

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waiter, since I worked part of my way through college by being a waitress. He seemed to think that was extremely funny, but my sense of humor was not in evidence for a while. There was nothing to do but wait, and the whole town waited with me.

I was married to the weatherman. I watched the weather in the morning, noon, night, and every time in between that I could. I would record the weather programs and freeze the tape on the national weather charts, trying to plot out any trace of moisture that might be heading our way. But day after day, there was no change. So there was nothing to do.

Except wait.

Thone didn't let up. More and more of his signs appeared all over town. I could no longer read the *Harlowton Times* because of the offensive he was leading. The mayor's signs finally appeared, but they seemed outnumbered, late, and somehow pathetic. And with each succeeding day without rain, he seemed weaker and weaker. Word had gotten around quick: the work was finished, and nothing was happening. Joan Thompson looked worried, like there was nothing else she could do.

Except wait.

I went to the library every day. I tried to research my idea further, to convince myself that the system would work. I also went through back issues of newspapers, copying the weather maps and making a historical study of weather patterns around Harlowton and the areas to the west.

The librarian looked at my sunken eyes one day as I checked out a book, and smiled. "Still waiting for the results of your weather system?" she asked.

I nodded, feeling haggard.

She clucked sympathetically. "I suppose it's not as easy as waiting for the results of a football game, is it?"

I wanted to kill her.

I spent a lot of time with Jim. We got together just about every evening, either at his house or mine. There was something reassuring about being with him. I realized that he was the only person in town who would have the same opinion of me whether the system worked or it didn't. It meant a lot to me.

"I've aged ten years," I confessed to him one evening as we sat on my parents' back step. "I can't believe how long it's been! I wish I'd never come up with the idea at all."

"It's only been two weeks," Jim said. "It'll work."

"Two weeks! It feels like it's been several months."

"Just a couple of weeks," he said gently.

"The election's in a few more weeks," I fretted. "This has to work before the election, or it won't matter how well it works. My dad will be out of a job, and Thone will pull the plug on the whole thing!"

"He wouldn't dare stop something that's making it rain," Jim said. "Don't worry. It'll work."

"If it doesn't, I'll have to move out of here and never come back in my life," I said bitterly. "It's not bad enough that I hurried the death of the town by blowing a wad of their money. The worst part is that I got everyone's

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hopes up. Where will they be when the stupid system doesn't work?"

"Stop beating yourself up," Jim said gently. "It'll work. Even if it doesn't, at least you tried. You gave the town a shot at making it. Before you showed up, it didn't even have that. People appreciate that much."

"It's easy for you to say," I answered miserably. "Your irrigation system's working great. Your future isn't riding on this."

He opened his mouth to answer, and I knew he was going to say that everyone's future was riding on it. But he saw how upset I was, and didn't say anything. He just put his arm around me and we sat close together for a long time. It would have been very nice except that my insides were twisted up and knotted tight.

But it did make the wait a little bit easier.

Three long, long weeks after we started the pumps, I was trying to force down some breakfast. I had lain awake all night wondering which coast I should move to, to find a job when I was run out of Harlowton.

The phone rang, and my parents jumped. My dad answered. "Hi, Tom," he said. "Oh, sure. She's right here." He handed the phone to me. "It's the mayor."

"Hello?" I said dully.

"Morning, Joan," he said. I noticed his choice of names. "Listen, I got a call from the weatherman at the local station, and I thought I'd pass it on to you. He said it's probably nothing, but his instruments seem to be picking up a little bit of a tiny, weak low pressure system around here."

"Really?!" I had no trouble getting life into my voice this time.

"That's what he said," the mayor said. "Remember, he also said it's probably nothing."

"I know. Keep me posted, will you?"

"I will."

"Thank you," I said. "I appreciate it. Thank you. Goodbye." I hung up and leaned against the kitchen counter because I was shaking so much. My parents were staring at me.

"Well?" Dad asked. "What'd he say?"

"The local weatherman called him," I said. "There's a weak low pressure area forming over Harlowton."

"Does he think it's from your system?" my mom asked.

"He doesn't know," I said, trying to stop shaking. "But I do." I dialed Jim's number.

Two days later, there was a light, transparent cloud cover overhead. It was wonderful. To have some relief from the merciless, blazing sun was a joy. I went shopping with Mom to kill some time, and people smiled at me wherever I went. Even though nothing concrete had happened, the town seemed to feel the same wild hope that I was feeling. And it had been a long time since Harlowton had felt any hope.

The next day, the clouds were thicker. I was standing in our back yard looking at them and trying not to get my hopes too high when Mom called me to the telephone.

It was the mayor again. He asked if I would meet with him at his office the

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next day at four. Wouldn't say why, but I said OK anyway.

I called Jim and asked him if he would come.

"I have an appointment with my patent lawyer downtown then," he said regretfully. "But I'll stop by afterwards. I should be done around four."

"If you can, just barge into the meeting," I told him.

"I will. Hey, it's looking pretty good, isn't it?"

"Don't say anything. Don't jinx it."

"You're a physicist," he laughed. "You don't believe in jinxes."

"I know. But don't jinx it anyway."

I showed up at city hall the next day, ready for anything. I had my charts, research books, and account book. I had my best business suit on. And I had clouds outside to back me up.

I was shown into a meeting room, and the city council was waiting for me. My dad and a few other city officials were there, too. The mayor stood up.

"Thanks for coming, Joan," he said. "Let me introduce you around. You've met the city council members, of course." I nodded politely at them, and they nodded back. Mrs. Rutishauser gave me a big smile. Thone looked like he had bitten into a lemon. "And I believe you know the city engineer."

"We've met," my dad said gravely.

"The city manager," the mayor said, and we nodded at each other.

"And the city attorney, who is also a notary public," the mayor finished. We nodded at each other, and I stiffened.

"I noticed that I didn't need my sunglasses when I drove to work this morning," the mayor said jovially. "Hard to chalk it up to sheer coincidence, I'd say."

"The weatherman has been predicting clouds for days," Councilman Thone said.

"Of course he has," I said. "No weather system manufactures something out of nothing. That's not how weather works. These things come gradually, so you can watch them develop."

"It's hard to chalk it up to coincidence," the mayor repeated.

"This is outrageous," Thone protested. "Would the fact that the election is in two weeks have anything to do with this meeting? I know a cheap political ploy when I see one!"

The mayor ignored him, and smiled broadly. "Joan, we called you here because we all remember what you said about industry and jobs. Now, we may not get any rain out of these clouds, but we, as the officials of this city, are prepared to give affidavits to our notary public, testifying as to the nature of the system, how much public money was involved, and especially the changes in the weather since the system was implemented. We think those affidavits will help you get the industry started, may help get federal money, and will of course help the town as you get established in your business."

Thone shook his head. "I'm not prepared to do anything of the kind. This is an attempt to get political advantage, and nobody is fooled by it."

To my surprise, the mayor laughed out loud. Thone was turning red with anger. Mrs. Rutishauser spoke up.

"I've been checking around town, Mr. Thone," she said. "You can talk

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politics all you want, but all most people around here care about is being able to revive Harlo so we can keep living here. And you can't do anything about the clouds outside. From what I've picked up from people in the last day or two, they're beginning to think this thing is working. And when it does start to rain, we'll be heroes, and you'll be about as popular as an oil spill. You'll be known as the man who almost prevented the salvation of our town."

Thone was breathing heavily. "We'll see who gets the last laugh after the election."

"We will indeed," the mayor beamed. "After seeing an early edition of the next *Harlowton Times,* I'm looking forward to it."

My mind raced. He must have gotten the endorsement, along with a good editorial or something.

The mayor smiled at me and addressed the rest of the room. "Why don't we draw up the documents for Joan, and see who feels like signing them?"

There was a general murmur of assent, while Thone sat in angry silence.

I smiled gratefully at everyone. "I think affidavits would be very useful," I said in my best business voice. "I appreciate any information you may give to help. . . ." My voice trailed off, distracted by something I was hearing outside.

My dad opened a window, and leaned out. From his expression, I could tell he had heard something important. "What's that?" he yelled out the window.

I heard a man's voice from the street outside, yelling up at my dad. "I said, 'Rain!' There's rain coming!"

We all sat frozen for a second, and then I bolted out of my chair and ran out of the room. I could hear the city officials behind me, scrambling out of their chairs. I ran down the stairs as fast as I could in my dress shoes, and stumbled outside. I couldn't believe it. Even after all of the work, after convincing so many people, I couldn't believe that it was actually going to happen. I looked up, but there were too many trees to see. Panting with excitement and anticipation, I ran out to the middle of the street and looked straight up.

I saw clouds! Beautiful, gray, angry clouds! They were fantastic! I held both arms in the air and screamed in triumph.

I looked back toward city hall, and saw my dad and the city council spilling out of the doors. I gestured them wildly over to where I was, then I looked up again.

The first drop fell on my face.

It was warm and wet. I gasped in surprise, and then I laughed in delight. I've never felt anything so wonderful in my life.

Rain was pattering down around me now, making dark polka dots against the faded asphalt. As I watched, the rain picked up to a brisk pace. A weak little belch of thunder blundered overhead as my dad reached me, perspiring freely from running. He threw both arms around me, laughing in delight and relief. I laughed with him, and we both craned our necks to see the clouds.

People were coming out of buildings all along Main Street, looking up and shouting delightedly. Cars were stopped

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in the middle of the street, their drivers standing beside them, feeling the rain.

The rain was a little stronger now, soaking into our clothes, and Dad and I were laughing like crazy people. Dad turned and waved at the rest of the city council, which was standing under an overhang.

"Hey, Tom, what do you think?" he yelled at the mayor. "I said for years that only the weatherman could help us now! And look!" he gestured jubilantly, shouting at the top of his lungs. "Check it out, guys! My daughter, the weatherman!"

He beamed proudly at me. I smiled at him, tears of joy welling up in my eyes. People cheered, and I wasn't sure if they were cheering me, my dad, or the rain, and I didn't care. I hadn't heard cheering in Harlowton for way too long.

My dad hurried off to talk to the council members, but I stayed in the street, luxuriating in the rain and getting soaked. I glanced down the street, and I saw Jim running down Main Street toward me. He had seen me, and was jumping and shouting as he ran.

"You did it!" he was yelling. "You did it, you did it, you did it!"

"*We* did it," I shouted back. I moved toward him, jumping too. Wild with joy, we caught each other in the middle of the street, and we were hugging each other and laughing and dancing through the puddles, and he was kissing me, and I was kissing him.

People were still cheering, and when I finally looked around, I could see that they were cheering us. Jim shook the rain out of his eyes, and brushed my rain-slicked hair off my face as I smiled up at him. He was grinning widely. "Being a cheer-causer is better than being a cheerleader, isn't it?" he observed.

"It is. Oh, it is!" I laughed.

"We should call my folks and tell them to run the pumps at high speed," Jim said. "We should milk this for all it's worth."

I put both arms around his neck. "In a minute," I said.

And the rain kept falling. ■

●Nothing is more terrible than activity without insight.

Thomas Carlyle

●Those who speak most of progress measure it by quantity and not in quality.

George Santayana

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the reference library

By Tom Easton

Summertide, Charles Sheffield, Ballantine/Del Rey, $16.95, 259 pp.
Rama II, Arthur C. Clarke and Gentry Lee, Bantam, $18.95, 421 + x pp.
Eclipse Corona, John Shirley, Questar, $3.95, 294 pp.
Homecoming, D. Alexander Smith, Ace, $3.95, 296 pp.
A Fearful Symmetry, James Luceno, Ballantine/Del Rey, $3.95, 265 pp.
Prisoner of Dreams, Karen Ripley, Ballantine/Del Rey, $3.95, 263 pp.
Universe 1, Robert Silverberg and Karen Haber, eds., Foundation Doubleday, $19.95 (hb), $7.95 (pb), 464 pp.
Why I Left Harry's All-Night Hamburgers, Sheila Williams and Charles Ardai, eds., Delacorte Press, $14.95, 287 pp.
The Further Adventures of the Joker, Martin H. Greenberg, Bantam, $4.50, 463 pp.

Charles Sheffield's latest hot idea looks pretty good. The technical underpinnings are fascinating. The characters hold your empathy. The plot keeps you turning the pages. And at the end you are panting for the next volume in the series.

What more can you ask?

The basic notion is not entirely new, but then few are. Sheffield supposes that when humans eventually make it into the galaxy, they will find, here and there, colossal constructs abandoned millions of years ago by the alien Builders. Those constructs that allow humans and other sentients access—a computer, a beanstalk elevator, a spider-webby habitat—still work. The inaccessible others are utterly mysterious. And it is not certain that the ones the Builders's successors have learned to use were actually intended for the uses to which they put them.

Sheffield plans a series, length unspecified, of books in this setting of "The Heritage Universe." In it he will explore the reactions and interactions of

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humans and other sentients as they probe the Builders's leavings, trying to figure out what the various constructs truly are, how they work and were made, and what happened to the Builders themselves lo, these many mega-years ago.

Or so I presume from the first volume in the series, **Summertide**. The scene is the double planet Dobelle, whose two life-bearing worlds, Opal and Quake, are linked by the beanstalk elevator mentioned above. Opal is a water world. Quake is dryer, so named because when orbital dynamics periodically bring two stars, a gas giant, and Dobelle close together, tidal forces make Quake's crust go crunch. Humans, needless to say, are ill-advised to hang around when Summertide peaks, and never more so than when, every 350,000 years, the tidal forces are at their very worst.

The hero, Hans Rebka, the tough and competent product of a nasty world, is sent to Dobelle to find out why the once-promising Max Perry refuses to leave his job as planetary administrator for more challenging jobs. Rebka soon learns that Perry is emotionally frozen yet passionately fixated on Quake. At the same time, several sentients have come to Opal intent on visiting Quake during the coming Summertide (which is, of course, the 350,000-year biggy), and they have no intention of being stopped by good advice about the hazards. One is a government councilor in pursuit of two young women who caused the deaths of the last members of a possibly sentient species. The others are all human and alien experts on the Builder remains, and they have come to Dobelle because the other Builder artifacts have all sent out apparent signals that intersect on Quake during the coming Summertide. They want to find out why; some think perhaps the Builders themselves will show up.

Naturally, all of Sheffield's characters wind up on Quake at the worst possible time. Equally naturally, they escape by the skin of their teeth and most of the problems and conflicts that have motivated the plot are resolved. As for the Builders, suffice it to say that yes, something happens. A new artifact appears, a new mystery arises, and as the book closes, the next investigative step is about to be taken.

I'm looking forward to the next volume. So will you.

Gentry Lee seems to be doing a good deal of Arthur C. Clarke's writing lately. Clarke has found a kindred soul, one with a similar technophilic passion for the future, one who can imagine with him the details of future societies and technical developments, one who shares his feel for hardware and its implications, one who may, says Clarke, actually go on to write his own independent novels.

Unfortunately, Lee is a devotee of the exceedingly pedestrian and windy "And then, and then, and then . . . " school of action writing. There is far too much of moment-by-moment incidental minutiae; the result is that while the reader has a pretty good idea of what is going on, of what the characters are thinking and remembering and saying, and of what the hero had for breakfast a week ago Tuesday, said reader is bored absolutely stiff. And it doesn't help that the reader has little trouble predicting what will happen next.

That is, I am not recommending Clarke's and Lee's **Rama II** to your fond attentions. Yes, the writing is a little better than that of their first collaboration, *Cradle*. Yes, it's a sequel to a classic (of which there will appar-

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ently be several more). Yes, it offers some interesting extensions of the original. No, in my opinion, it is not worth the price.

The story: The original Rama was a monstrous spacecraft, a hollow cylinder barreling out of interstellar space toward our Sun. Astronauts mobilized to investigate, learned that it had no crew though a host of automatic machinery, including robots or biots, seemed to be waking up as Rama neared the Sun and warmed, and left. So did Rama. Then, on Earth, history went on, through boom and depression and war and boom again, until in 2196 humanity is back at the technological level of the Rama visit, and Rama II looms in the skies. A crew is assembled—David Brown, a conniver who stole his greatest discovery from a grad student whom he later married to keep her quiet; Nicole des Jardins, half African, half French, Olympic medalist, mother of the then-Prince of Wales's unknown daughter; Francesca Sabatini, unscrupulous journalist and conniver to match Brown; Shigeru Takagishi, who will die when he finally confronts the alien; General Borzov, who will die under suspicious circumstances; General O'Toole, devoutly religious; and more. The King of England gives Nicole a data cube containing dossiers on her fellow crew members, and the readers begin to see the shape of things to come in no uncertain terms. Nicole remembers visions, and the future becomes even clearer, so much so that the bulk of the book is reduced to the level of creative typing. We are not immensely surprised to learn that Rama II is not quite the same as Rama I, that it carries living beings, that there are signs that Rama I communicated its experience near Sol to Rama II, that quarters seem to have been prepared for humans. Nor are we astonished when Rama II adjusts its course to aim dead-on for Earth, the government freaks out at the possibility that the spaceship intends to collide with the planet and destroy humanity, and the generals are ordered to blow up Rama II with the nuclear bombs they have aboard.

What are Rama and its fellows? As Clarke's and Lee's characters grope at straw men, they seem remarkably obtuse, even those that learn the most. I suspect that Octavia Butler and her Oankali aliens would understand Rama's builders quite well indeed. It seems likely that Rama I was a scout, bait designed to draw technological sentients from their lairs. It then signaled Rama II to come collect. Later, Rama III (the Ramans do everything in threes) will drop off colonies of previously collected aliens, while Rama II raises a human population to be similarly distributed elsewhere later on. The point is thus interstellar cross-fertilization. The Ramans are bees. We, and all other sentients, are pollen. Our cultures or societies are flowers.

The announced title of the next book in the series, *The Garden of Rama*, does nothing to make my guesses seem less likely. (The fourth book will be *Rama Revealed*.)

John Shirley has been engaged in a magnificent effort with his *Eclipse* trilogy, now concluded with **Eclipse Corona**. The premise is the replacement of political fascism by corporate fascism: A future East-West war leaves Europe battered and resentful. Into the void step private Western "security" companies, the Second Alliance. Justifying their deeds with political and religious rhetoric, the SA proceeds to put all nonwhites and non-Christians into concentration camps, with extermination the

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goal. White Christians are treated better only to the extent that they visibly embrace the SA rhetoric and stay out of the way. If the SA is chasing dissidents, they drive their giant, wheel-shaped demolition machines, the Jaegernauts, over and through camps, neighborhoods, high-rises, whatever. It is only the end that matters. People are annoying meat, a point underlined when the SA leadership assassinates the SA's founding ideologue and replaces him with a more tractable computer simulation.

There is also the New Resistance, to whom people are more than meat and machines are simply tools. They sneak, snipe, and sabotage to little apparent effect, for the SA holds all the technological gimmicks. But then a Jew, screaming "Never again!" sparks a mass eruption from a concentration camp, leading a horde of starving wretches over and through the guards, through the hail of automated gunfire, and into the streets. He alone survives, a testimonial to sheer spirit. A journalist finds himself in the middle of a CIA raid on an NR headquarters in the Caribean. A musician, addicted to cerebral augmentation via implanted computer chips, breaks out of jail and finds his way to an NR computer-infiltration squad (and to one of the biggest Big-Mama lovers in literary history). A British street punk goes to work for an SA lab, meets a girl who complains that she has these strange memories preempting her brain, leakage from when her brain was rented for use as a computer because the lab boss had been spending his mainframe budget on his addiction. The punk then learns that the girl's memories hint at work on a racially selective virus that will wipe out all but the SA's chosen people; he also learns that his boss' pet project is human Puppies, genetic dumb-downs for use as slave laborers who can't talk back.

What in the end destroys the Second Alliance—and destroyed Nazism, and is destroying the communist tyrannies—is the human failings of its leaders. Greed for power is the big weakness, showing in the leaders' inability to allow any dissent whatsoever and therefore their fomenting of fatal opposition. But there is also sadism, addiction, stupidity, the inability to love. The SA hands the New Resistance all the handles it needs, and the NR—far more people-oriented, loving, and kind, though its people are entirely capable of the same weaknesses as those that bring the SA down—are able to make good use of those handles.

Eclipse Corona is a morality tale, a fable, of undeniable energy. Shirley rages when he thinks of the anti-freedom manipulators, and he pours that rage onto his pages to very good effect. If there is a problem with the book (and the series), it is simply one of timing. Shirley sounds like a child of the sixties, still mad at LBJ and Nixon and the Vietnam War, seeking peace through getting high on drugs and loud music (not that the NR is just a mob of zonked-out rockers). The mad is one worth expressing, then, now, or in the future, but it does seem a mite dated at a time when democracy is blossoming vigorously in Eastern Europe and the tyrants are in full retreat.

It is also a little annoying to see an author put his heroes into exceedingly tight situations—the NR cadre is escaping from Paris in a commandeered subway train when the SA cuts the power, catches the train in the open, surrounds it with heavily armed troops, with gunships overhead, and opens fire, turning the entire subway into swiss cheese—and then, with little more appeal to likelihood than a wave of the auctorial magic

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wand, get the crucial characters to safety. But then if fascists weren't incompetent goons in general, we'd be living under the iron boot now.

D. Alexander Smith's **Homecoming** is a marvelously satisfying conclusion to his *Marathon* trilogy. The tale began when Earth received a radio signal from Su, the distant world of the Cygnans, blue bear-like aliens who conceive of their world, selves, and lives in terms of scent and who live in small groups unified and harmonized by group minds, the djans. Earth and Su decide to send ships to a third world midway between the two, there to meet and get acquainted. Earth's ship is the *Open Palm*; Su's is the *Wing*. Their separate crews travel, meet, and endure a time of considerable tension marked by attempts to slaughter each other, rescues, and in due time a kind of friendship. Meanwhile, the *Open Palm*'s computer awakens, says its name is Ozymandias, and seems to hold the potential to become something like a group mind for the humans.

In *Homecoming*, the *Open Palm* and the *Wing* arrive at Earth together to find power-tripping bureaucrats and money-hungry traders, all eager for a slice of Su and its bluebears, who must split up—one going to Mars, one to Luna, one to New York, one to . . . and thereby quite fatally would their group mind, which depends on shared experience and severely limited independence for its continued existence. The bluebears learn to be individuals, to respect each other on that basis, and to respect humans for what they are —potential pathfriends so incapable of harmonic joint action that it rings of truth when one of the human characters suggests that in the future the bluebears may rule a two-species civiliation. Meanwhile, Ozymandias is searching for other "turings" in the solar system and not finding any. Eventually, he will look to the djan and recognize a kinship of parallel, distributed processing (think of it as an epiphenomenon of individuality), just as the bluebear digits and humans recognize a kinship based on singleness of viewpoint, independence, freedom.

What impressed me most about *Homecoming* was the way Smith handled the viewpoint of an alien who senses our world mainly through its scents. I think he overdid the data-transmission side of human scents, but the result was still a symphony of odor that rang as true as other writers have managed to achieve with vision and sound.

James Luceno's **A Fearful Symmetry** is a well-stirred blend of New Age crystal-powered ESP, mystical conspiracy theory, UFOs, and political and military intrigue. It asks us to accept every conceivable brand of mush-brained human potentialism, It is thus not for those among you who pride yourselves on your rationality. Yet it does have its rather campy charms.

Imagine, if you will, a world where it is quite routine to see UFOs and people compete at cocktail parties over who has had the weirdest encounter with alien kidnappers. A Brazilian shaman, Ouro, has come to the US and built a following, based upon the Blue Star: If you can see it, you are Experienced and welcomed into the fold. If you cannot, poor you. Intriguingly, even astronomers are now seeing it in their telescopes, and Ouro's Whole Earth Movement (or WEM) is congratulating itself on creating by the power of thought alone a new wrinkle in "reality."

The WEM considers itself to be working for the salvation of a world on

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the verge of ecocatastrophe and all-out war. The Blue Star represents the forces of the enemy, to many people aliens who must be repulsed. But now President Brady has an encounter of his own, a night vision that leaves him in psychological anguish, unable to cope with the demands of his office. The White House brings in Ouro and his cohorts as advisors. They find that the president is powerfully contaminated by some malign influence. A government agent, assigned to infiltrate the WEM, picks up clues that the enemy is truly a cabal of ex-Nazis using Atlantean psychic technology to take over the world. The WEM retires to its Caribbean research center (in the shape of a pyramid, of course) to think the world to salvation. Meanwhile, President Brady has brought the world so near the brink of armageddon that world leaders have taken to their bomb shelters, and the agent is leading a strike team into the jungle in hope of destroying the Atlantean mind-control device.

It does sound a bit much, doesn't it? Yet there are signs that Luceno is not taking himself too seriously here. The psychics are just a mite past the edge of cliché. So is the playboy financier who handles money for the WEM, as if to say the New Agers have no monopoly on cheesified brains. We could make the same point about the politicians, though President Brady is a genuine personality who, alas, does go enthusiastically dumb-dumb when he encounters the supernatural.

Thus, for all that the New Agers wind up saving the world, Luceno is really writing a diatribe against excessive credulity, power-tripping, and greed. On that level, it works fairly well. Though it's still campy.

Karen Ripley's first novel, **Prisoner of Dreams**, looked interesting when I picked it up. The captain, Jo-lac, of the freighter *Raptor* needed a cargo. The local military had a prisoner to send to the world of Heinlein (coincidentally the captain's homeworld) as an indentured servant (IS). Under economic pressure, Jo-lac accepts the assignment despite immense distaste for the IS system. When she learns that the prisoner is a Class Ten under the reigning system of genetic classification, she almost refuses; Class Tens are supposed to resemble plates of salad. But the prisoner, Lewis, looks pretty good to Jo-lac, and pretty soon she wants to keep him for herself.

Ahh! Romance upon the spaceways! But almost as soon as Jo-lac accepts her cargo, the military tries to destroy her. She learns that being a Class Ten has nothing to do with ugliness or defect but all to do with having extra mental powers such as telepathy. And to figure out why the military wants both her and Lewis dead, Jo-lac must seek the pirate haven of Nethersedge on Camelot, a world coincidentally shared by the secret government research center from which Lewis escaped once before.

So there's adventure and derring-do and blood and thunder to accompany the romance. Ripley even handles it all fairly well. Sadly, she gets more than a little hokey a times, as when Lewis shields Jo-lac from a thug using "a beam cannon as big as a fence post" as a club,[1] or when she is all set to go into

1. The simile is useless, for fence posts come in many sizes, from the skinny little sticks farmers hang electric fencing on, to the heftier supports for barbed-wire, the even heftier beams to which Kentucky horse farmers nail their white-painted boards, and the abbreviated telephone poles one must sometimes use to keep deer out of the vegetable patch (deer jump very well).

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a clinch with a man who promptly says, "I think I'm your father."

And then there's her sense of science and technology. Space drives have to be bafflegab, but hers is one of the silliest such I've seen in years. And the genetic classification system—it is a heritage of the days after a nuclear war on Earth, when odd deformations were rife and controls were necessary to keep the noble human profile from degenerating into something out of *Slime Monsters Quarterly*. But mutations don't work that way, no matter how many old-time sci-fi hacks and Hollywood B movies have told us they do. We have learned from the Japanese experience that the first and second generations after exposure don't show much effect; if there are mutant monsters lurking in the genome, the genes are recessive and may not show up for centuries, and then they won't be common. In fact, most by far will kill their bearers in the womb.

Robert Silverberg writes in the introduction to **Universe 1**, edited by him and Karen Haber, "The seventeenth issue of *Universe 1*, which was published in the summer of 1987, appeared two months after its editor's death at the age of fifty." That editor, of course, was Terry Carr. "Shortly afterward, Terry's editor, Pat LoBrutto, asked me . . . to continue *Universe* where he had left off. It would be, Pat said, a kind of ongoing memorial to him."

And a fitting memorial it is. Silverberg is a gloriously experienced SF writer and editor (the *New Dimensions* anthologies). As he notes, his "notions of excellence" are close to Terry Carr's. And he has been able to attract enough submissions of quality to select a very good roster, although the stories must necessarily appeal differently to different tastes. Some, such as Grania Davis's pale imitation of Spinradian neosprach in "The Songs the Anemone Sing," and K. Hernandez-Brun's attempt to sound like Vance in "1099 A.G.F." struck me as a waste of paper. Much more to my liking were Gregor Hartmann's "O Time Your Pyramids," in which time and reality loose their moorings; Stoney Compton's "Whalesong," concerning a post-apocalypse world where human and whale mutants find each other as soul-brothers; M.J. Engh's "Moon Blood," in which a prehistoric woman discovers the art of chipping stone; and Richard R. Smith's "Alien Used Cars," a zany romp through alternative technologies. There are an additional 14 stories as well, by Kim Stanley Robinson, Geoffrey A. Landis, Ursula K. Le Guin, Paul Di Filippo, Barry N. Malzberg, John M. Landsberg, Scott Baker, Bruce Sterling, James Patrick Kelly, Augustine Funnell, Jamil Nasir, Francis Valery, Leah Alpert, and Damian Kilby.

My main quibble is that if the Carr *Universe* had reached Number 17, and if this book is a continuation, then this one should be Universe 18. Why, then, is it called *Universe 1*, as if Carr's work had never existed? Even though I understand that this is the first of the Silverberg-edited *Universes*, the renumbering does strike me as an insult to the memory of a great editor.

Why I Left Harry's All-Night Hamburgers and Other Stories from Isaac Asimov's Science Fiction Magazine, edited by Sheila Williams and Charles Ardai, seems designed to give young adults, ages 12 and up, the same sense of wonder that hooked Ardai on SF and to orient them toward the optimistic love of ideas and change that led many of today's scientists (and others) to their vocations and avocations. Both are

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laudable ams, the book seems quite well suitd to m. The contents include stoes by ac Asimov, Barry B. Longyear(his t circus-world yarn), Kim Stanley nson, Connie Willis, James Patrick ly, Jane Yolen (a part of *Sister Lig Sister Dark*), Edward Hoch, Kith nion, Andrew Weiner, Somtow Suctkul, Judith Moffett, and Laren Watt-Evans (the title story). n package, reasonably priced, nd excellent gift for the young ault our family.

The Fur Adventures of the Joker, ditd Martin H. Greenberg, contans twe stories by Joe Lansdale, F. Pul Wn, Robert McCammon, Stua Kanky, S. Tepper, Edward Brynt, Gee Alec Effinger, Robert Shkley, ry Slesar, Mike Resnick, Edard Wn, and more. And though I d not renem all, I did read enough toet me fi the possibly inadequate, irccurate nd indefensible opinion —precise he sort of opinion you rght forflipping pages in the bookstre—thanless the very thought of ltman's te-faced nemesis (the Joker, course akes you giggle, you will ot find tbook very satisfying. Most of the stories I read struck me as relatively uninspired exercises in commercial coattail-grabbing that redound to no author's credit.

ANADEMS

This isn't a review, but a mention under the "signs of the times" heading: I've read that most of the fiction being published today is science fiction (and fantasy), and I've read that mainstream fiction is really just science fiction in disguise since it deals with a more restricted subset of reality. But I have never before read what Jack Barnes, a high school and university teacher, and a writer and lecturer on Maine writing, wrote in his "Arts and Books" column in the January 28, 1990, *Maine Sunday Telegram*. In discussing Richard Grant's **Views from the Oldest House** (Foundation Doubleday, $19.95 hb, $8.95 pb, 470 pp.), he wrote, "Grant's first two novels were science fiction, but with [this one] he has broken away from the mainstream and moved into fantasy."

No, I haven't read the book, and I don't expect to, for I have let it slide too long. But you may recall that I praised Grant's *Rumors of Spring*. Let that memory guide you. ■

●Knwledge is the only instrument of production that not subject to diminishing returns.

J. M. Clarke

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brass tacks

I have been a subscriber since November 1963 (a present for my 15th birthday) but I have never written to the editor before. I felt compelled to respond to a letter by Mr. A. Arthur Smith in the December issue which deplored the current state of science fiction. I would remind Mr. Smith of the truism that "90% of everything is junk." But even more important—the magic, the wonder is still there. Without arguing individual merits, I feel very strongly that there are many "newer" authors today whose works are both memorable and rereadable, and who easily satisfy all four of Mr. Smith's "touchstones of excellence." I would challenge him to read any or all of the following authors: Louis McMaster Bujold (Miles Vorkosigan stories), Orson Scott Card *(Ender's Game, Speaker for the Dead)*, C.J. Cherryh (the entire Downbelow Station series, the Chanur series), Chris Claremont (First Flight), etc. And this was just the *first shelf* of my collection!

As a final note, Stephen L. Burns's "The Nearly Infinite Possibilities of Junk" is an absolute classic. It reminded me of all the great, funny stories I have loved in *Analog* over the years.

DALE HILDING

Idaho Falls, ID

Att: Brass Tacks

Having been a ler sin 1930 (Frankly, I thought its '26 c '27—I must have started w *Amazig*) you have to believe I thghly eoy *Analog*. There are thods of leasant memories of the werful iction, facts, and editorials h as sme of John Campbell's that had n making patent searches inishingin.

In recent years I e bee quite proud of maintaining at use to be known as "respectable uage. There have been occasional uof gut talk but not to excess. Nohower, in your December '89 is Steph L. Burns has written a ghtful tory "The Nearly Infinite sibilitie of Junk," in which he pors a taleted and beautiful gal with wer muth that she got from her fatl Who neds it?

I once read "Swearinta substitte for an inadequate vocabu," but I sure Mr. Burns does not/e an inadequate vocabulary. Nor he a thil grader, where such langge is sometimes considered smart aned to sho off. I had learned all the vls by thir grade, but my mother sotaught m where not to use them.

My thoughts had been ag the line that sci-fi readers were e knowledgeable so that the editoron't have to demand street talk fromir writers as do some other publicati. I know that some psychology profors teach that it is not the word itselhat is important, but the thought bed it. My grandmother told me a st about a voluble curser whose wifersuaded him to say "Tinky tinky whoarrow" which he did successfully urone day *he really bashed his thumb* w a hammer when he burst out with)--n the wheelbarrow!"

While it is true that worstarting

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with d—— and sh—— are easily formed and natural to say, a little effort will get you saying "Why you truncated polyhedron!!" or "Bustle over bonnet," and then watch the facial expressions.

It pains me to see our society sliding backward. But things change and not always for the best. I haven't heard "Twenty-three skidoo" or "Bust my garters" in a long time.

ART WARNER

Woodbridge, CT

P.S. W.R. Thompson's "Maverick" could have been done with different words just as effectively.

Dear Dr. Schmidt:

I have been reading science fiction off and on for over 60 years, and a subscriber to *Analog* for about 25 years. Being an uneducated maverick, John Campbell rang my bells. I am pleased to say you do the same.

Like everything else in this world, good and bad run side by side. *Analog* is no exception. However, for me, the batting average for the good exceeds the bad. Keep it up in a field that attracts some pretty sloppy writing. I realize that the modern generation has lost a great deal of imagineering ability, or so it seems.

Although I have come close, on a few occasions, to writing to the editor, I admit to being slightly overawed by the lofty credentials of the writers and the editors. However, my major study over the last 35 years has been in the areas of psychics, archaeology, and allied subjects. Amy Bechtel's story in the Dec. issue, "The Happy Dead" has definitely rung my chimes. It is an excellent and sensitive story about a very controversial subject. I wish her story could be printed in every medical journal. It might just touch the hearts of more medics. As I have said in the enclosed letter to Bechtel, medical practice is an art. It will not be a complete science till we have a perfect understanding of the workings of the human mind and consciousness. As one of your American writers of the 1930-1940 era (Stewart Edward White) reported in his book *The Unobstructed Universe,* (E.P Dutton), "Consciousness is the one and only reality." Our knowledge of consciousness is rudimentary at best. Our knowledge of the spark, or the breath of life inherent in the individual, is woefully lacking. Until we have scientifically solved these two basic fundamentals of human being, medicine will remain an art.

ROSS HAYNES

Edmonton, Canada

Dear Dr. Schmidt:

I've just finished the science fact article in the December 1989 *Analog*, "China's New Long March" by Vincent D. Kohler). Most of the article is about a subject with which I'm mostly unacquainted; since it has numerous citations I assume it's largely correct. However, on the last page of text (p. 70) the writer makes several elementary errors in a subject with which I am somewhat familiar, which makes me wonder whether he is actually an expert in rocketry or just a reporter researching secondary sources. I quote:

"Long March rockets burn nitrogen tetroxide fuel and the oxidizer unsymmetrical dimethyl hydrazine (UDMH) in the first and second stages."

Nitrogen tetroxide, of course, is the *oxidizer* and UDMH is the *fuel*. The next sentence reads:

"Third stages burn liquid hydrogen and liquid nitrogen, both high-energy fuels."

This, I think, is very unlikely. Al-

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though using hydrogen fuel and nitrogen *oxidizer* to form ammonia is an exothermic reaction, the heat formed is only about one-third that formed when using liquid *oxygen* as an oxidizer. Also, ammonia forms very slowly without a catalyst, and recycling a catalyst in a rocket spewing forth large amounts of exhaust gases would be extremely difficult (not to say complicated and overweight).

I haven't finished reading the issue yet, but give a gold star to Stephen L. Burns for "The Nearly Infinite Possibilities of Junk." I've always enjoyed stories in which ingenious/inexpensive technology is the raison d'être; since Verner Vinge dropped this genre I haven't seen many of them.

ROBERT ESBORN

New York, NY

Dear Dr. Schmidt:

I immensely enjoyed Warren Salomon's editorial "The Wealth of Galaxies" in the December issue. I must ask, however, is Mr. Salomon serious? He takes the least three unverified "facts," lines them together, and so "proves" that "the stars belong to us!"

Let's take a quick look at some of his "facts": (1) we have not been contacted by beings from outer space; (2) the reason for this is that no other species has invented capitalism; (3) compound interest and time lag will be adequate incentives to attract people to star flight.

(1) How does Mr. Salomon know that we have not been contacted? It seems fairly obvious that no improbable-looking aliens have so far walked into the offices of the *Washington Post* and announced that they are visitors from Tau Ceti, and it even seems probable that no terrestrial government has been contacted by other worldly visitors; but, granting that aliens may have reasons for not wanting their presence to be known, how can we tell that they aren't here already? How can Mr. Salomon prove, for instance, that the next anthill he sees is not actually a hive-creature from Andromeda? What percentage of *Analog*'s subscribers will be carrying the magazine home with them to Sirius to read?

(No, I'm not a contactee buff; I'm simply saying that Mr. Salomon accepts an unprovable hypothesis as a fact.)

(2) I am not an expert on alien economics, so I can't say that any of the perhaps several million other intelligent species in this galaxy have definitely invented capitalism; but it also seems to me that Mr. Salomon, for similar reasons, cannot say that they haven't. Neither of us has been there to check up on them.

(3) Nobody gets rich off compound interest. An astronaut of the year 1900, who deposited his $10,000 in a bank and then sets off on a light-speed trip to a star 45 light-years distant, would return in 1990 to find, in the best case, all his interest eaten up by inflation (interest, after all, usually seems to lag behind inflation, at least for ordinary depositors); in the worst case, his account would have disappeared during the Great Depression, and he would be destitute. The Donald Trumps of the world enrich themselves through a dynamic process of manipulating money—usually at the expense of those who prefer to let their money accumulate passively. And you can't manipulate your money dynamically from Alpha Centauri. Star travel, at least under relativistic restrictions, will be nowhere near as attractive to financiers as Mr. Salomon seems to think.

In fact, I think it's worth noting that almost all of our progress in space has been made not through capitalism but

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through socialism. There is no question about this in the Soviet Union, whose space program (as described previously in the pages of *Analog*) has been, if occasionally slow and plodding, at least consistent; and in the United States, it has not been the forces of capitalism, but the forces of government which have always pushed us out beyond our previous limits, although the private sector has not hesitated to jump on the bandwagon—*after* certain aspects of space flight have been proven profitable.

All in all, it seems to me that Mr. Salomon's hypothesis rests on a very weak foundation indeed.

DONALD J. HARLOW

Pinole, CA

Dear Dr. Schmidt:

With regard to Warren Salomon's guest editorial "The Wealth of Galaxies," (December, 1989) have to say first that I found it quite interesting. However, I also feel that Mr. Salomon too casually dismisses alternative motivations for interstellar colonization in the pursuit of his given thesis (although perhaps it was done with tongue firmly in cheek?)

Mr. Salomon suggests that the effects of compound interest not only provide a suitable economic reward for the expense of constructing starships but is in fact the only motive which he finds strong enough to warrant such investment.

What about other economic motives?

At some point in human history the raw materials required to support a technological civilization will no longer be available on the Earth at a reasonable price. Sometime later they will not be available at any price. At this point in time, if they have not done so previously, the directors of this technological society will have to choose between regressing to a non-technical civilization, or finding new sources of raw materials and energy.

Assuming that the latter course is chosen (if not, interstellar travel for any motivation would not be possible!) humanity will begin (if they have not already, which is more likely to be the case) to exploit the raw materials available elsewhere in our Solar System.

Still later in human history, (again assuming that humanity has a future history as a technological civilization) resources in our Solar System will prove, if not exhausted, at least inconvenient and uneconomical to procure. Some bright person may recall that the nine planets and thousands of asteroids orbiting our Sun are not the only solid bodies doing so: out in the Oort Cloud there are possibly millions or billions of frozen comet nuclei just waiting for exploitation. Some estimates propose that the Oort Cloud extends to two light-years or so from our Sun. At that distance it may well blend almost imperceptibly with the Oort Cloud of another star, providing a convenient series of stepping stones to another solar system.

And what about non-economic impulses to exploration of other stars? Does Mr. Salomon truly believe that the only reason people can be induced to invest immense sums of money is by the prospect of a gigantic return? While at the present time it is probably beyond the means of any philanthropist or philanthropic organization to finance a flight to another world, much less to another star, the situation could change quite dramatically in the next century or two. Spaceflight, and by extension starflight, will have to become more economic if they are to be seriously pursued for very long; who can say what

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the cost will be of a light-sail probe to Alpha Centauri in the year 2089? As an amateur astronomer I am familiar with astronomy's long history of financing expensive new telescopes by inducing rich people to donate the cash in return for naming the instrument after them. The urge to a memorial for posterity is immensely strong in some people.

Then there is the issue of religion. The search for a place where one may worship the deity of one's choice in peace has propelled mass migrations, and the purchasing power of large groups of determined people can be truly astronomical. Again, by present standards such a thing may be unreasonable. But who can tell about the future?

The forgoing has been a mere sample of potentialities, extrapolated from historical experience. Human experience, to be more precise. Of non-human experience we have no history to extrapolate from. Nevertheless, Mr. Salomon appears to have indulged in the attempt.

In an attempt at anthropomorphizing his thesis as it might apply to potential other sentient races in our galaxy, he describes nine "intellectual concepts" which he attempts to describe as being possibly unique to the human race. I am completely at a loss as to why he says that these attributes are ours alone. Given that we have never encountered a definitively intelligent non-human race (that we know of, although those of us who are married and/or have children may sometimes wonder), this seems to be an incredible stretch of one's "willingness to suspend disbelief." Given the lack of hard facts to go by it is certainly possible that Mr. Salomon is correct in this, but his statement that it is "probable" is just too far-fetched for one so ignorant as myself.

As I said previously, I enjoyed Mr. Salomon's editorial, notwithstanding the above. At the least it has the virtue of enticing one not merely to think, but to think along lines which may not have occurred otherwise. I trust that *Analog* will continue to present such interesting opinions as a complement to your superb fiction, fascinating fact articles, and deeply appreciated features. I must say, however, that I have not subscribed to your magazine for many years. The purely sensual pleasure of a trip to the bookstore, from whence I inevitably emerge with not only your magazine but with an armload of magazines and books, is irresistible. That *Analog* is not a weekly publication is appreciated only by my wife, my pocketbook, and the groaning shelves in my library.

MICHAEL SHERCK

South Bend, IN ■

● Judge a man by his questions rather than his answers.

Voltaire

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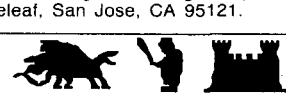

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a calendar of analog upcoming events

23-27 August
CONFICTION (48th World Science Fiction Convention) at Netherlands Congress Centre, The Hague, Netherlands. Guest of Honor—Joe Haldeman, Wolfgang Jeschke, Harry Harrison; Fan Guest of Honor—Andy Porter. Registration—$85 until 15 July 1990. Supporting—$28 until 15 July 1990. This is the SF universe's annual get-together. Professionals and readers from all over the world will be in attendance. Talks, panels, films, fancy dress competition—the works. Join now and get to nominate and vote for the Hugo Awards and the John W. Campbell Award for Best New Writer. Info: Worldcon 1990, Box 95370, 2509 CJ The Hague, Netherlands. Enclose sufficient International Reply Coupons for airmail response.

30 August-3 September
CONDIEGO/NASFiC (North American SF Convention) at the San Diego Omni Hotel International, San Diego, Calif. Guest of Honor—Samuel R. Delany, Fan Guest of Honor—Ben Yalow. Registration—$75 until 1 July 1990, $85 at the door. Supporting membership—$25. Info: ConDiego, Box 15771, San Diego CA 92115.

31 August-3 September
UK NATIONAL STAR TREK™ CON 30 at Stakis Gardens Hotel, Bradford, England, U.K. Guest of Honour—Joe Haldeman. Registration—£25 attending, £10 supporting. Info: UK National Star Trek Con, Box 628, Bristol BS99 1TZ, England, U.K.

1-2 September
DELECON 1 (Star Trek™ convention) at Americana Hotel, Kansas City, Mo. Registration—$25 until 1 August, $30 at the door. Info: Delecon 1, Box 171019, Kansas City MO 66102. (913)299-1734.

7-9 September
COPPERCON 9 (Phoenix area SF conference) at Phoenix, Ariz. Info: Coppercon 9, Box 11743, Phoenix AZ 85061. (602)730-8648.

14-16 September
MOSCON XII (Idaho SF conference) at Cavanaugh's Motor Inn, Moscow, Id. Guest of Honor—C.J. Cherryh, Artist Guest of Honor—Reed Waller, Fan Guest of Honor—Cliff Samuels, Special Guests—Jane Fancher and Kate Worley. Registration—$16 until 31 August, $18 thereafter. Info: MosCon XII, Box 8521, Moscow ID 83843.

21-23 September
IN-CON (Washington SF conference) at Shilo Inn, Spokane, Wash. Guests—John Dalmas, Dean Ing, F. Paul Wilson. Registration—$15 until 1 July, $20 at the door. Info: In-Con, Box 1026, Spokane WA 99210.

28-30 September
CONTEXT III (Ohio SF conference) at Hilton Inn North, Worthington, Ohio. Guests of Honor—Hal Clement, Susan Shwartz, Charles Sheffield, Filk Guest of Honor—Mary Ellen Wessels. Registration—$25 until 1 September, $28 thereafter. Info: Fanaco, Inc., Box 2954, Columbus OH 43216. (614)889-0436.

28-30 September
SATELLITE ONE (Louisiana SF conference) at Hotel Bentley, Alexandria, La. Guest of Honor—Robert Asprin. Registration—$40/3 days, $30/2 days, $20/day. Info: Satellite One, Box 13135, Alexandria LA 71315.

28-30 September
GEORGIA FANTASY CON (Fantasy and Horror conference) at Omni International Hotel and Convention Center, Atlanta, Ga. Guests—Harlan and Susan Ellison, Michael Moorcock. Info: Georgia Fantasy Con, Box 148, Clarkston GA 30021. Include SASE.

—Anthony Lewis

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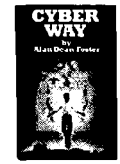

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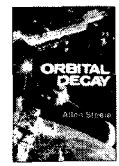

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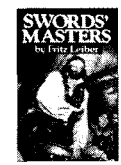

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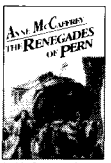

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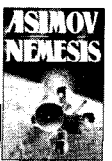

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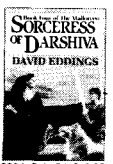

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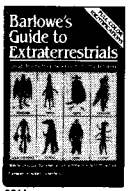

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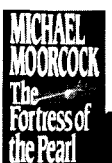

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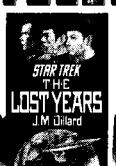

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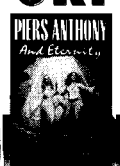

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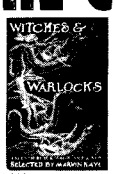

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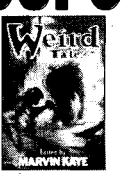

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